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ABSTRACT

This volume includes 29 papers as well as abstracts of several additional presentations from a conference that focused on the process of developing Pacific telecommunication resources to meet the basic needs of the region and on ways of resolving the problems that arise as part of the process. A wide range of current information is provided on needs, resources, and value issues. Papers are grouped by session on the following themes: (1) communication needs of businesses in the local, national, and regional marketplace; (2) needs for telecommunication in rural communities; (3) communication needs of minority groups; (4) meeting the needs: technical and institutional responses; (5) developments in high technology; (6) telecommunication and information technology to meet basic needs; (7) providing for telecommunication service requirements in the local, national, and regional marketplace; (8) effects of telecommunications on daily social activity; (9) problems and progress of new technology; and (10) economic demand for telecommunications as a reflection of needs in the Pacific Region. Some papers provide references. (LMM)

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PTC'84 Proceedings

Edited by
Dan J. Wedemeyer
L.S. Harms

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Edited by

Dan J. Wedemeyer
L.S. Harms

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January 8-11, 1984

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PTC'84

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Foreword

PTC'84 continues the discussion on 'Telecommunication Development in the Pacific.' Participants who have attended earlier PTC conferences will find that the over-all conference organization resembles that of previous years and that two new options have been added. These options are called *study groups* and *working groups*; they increase the opportunities for interaction among conference participants.

The conference program opens with a special session on Sunday afternoon. On Monday, Tuesday and Wednesday, the conference day begins with a plenary session that sets the theme for the day. Each plenary session is followed by three concurrent paper sessions, just as in the previous PTC conferences. Tuesday's lunch features a keynote address which examines the prospects for business in the Pacific Basin.

On Monday and Wednesday afternoons, a number of study groups are scheduled; these groups replace the afternoon panels of previous PTC meetings and are intended to promote open and informative discussions on selected topics. In two cases, resource papers have been prepared for the groups' use.

On Tuesday afternoon, about twenty working groups are scheduled. These groups are small, and focused on topics proposed by PTC members. It is the hope of the conference committee that many of these groups will continue to work throughout 1984 and that some of the groups will report on their work during PTC 1985. Naturally, the tools of the trade, especially some of the newer forms of teleconferencing, are appropriate for this ongoing task. While the working groups are scheduled for a two hour period in the early afternoon, the late afternoon and evening on Tuesday are open to permit those groups that wish to do so to continue their work beyond the two hours allocated in the formal conference program. On Monday and Wednesday, the conference day concludes with a PTC all-conference roundtable.

The conference as a whole is organized to examine the relationship between telecommunications needs (Monday) and the resources now available or becoming available to meet those needs (Tuesday). When resources are systematically developed to meet needs, a number of issues and problems arise and require resolution (Wednesday). The opening keynote addresses (Sunday afternoon) and the closing banquet address (Wednesday evening) illuminate the rights of everyone in the Pacific to the telecommunication resources required to meet basic communication and information needs. In sum, the conference focuses attention on the process of developing Pacific telecommunication resources to meet basic needs and on ways of resolving the problems that arise as part of this process.

The papers in this volume provide a wide range of current information on needs, resources and value issues. The papers are arranged in the same sequential pattern as the conference itself. In cases where papers were not yet available at press time, blank sheets are included for your written notes. Also, note sheets are included for the working groups.

On behalf of the authors, the conference organizers and sponsors, we extend our Aloha to you…we hope you both enjoy and benefit from the sixth annual Pacific Telecommunications Conference.

Dan J. Wedemeyer
L.S. Harms

Honolulu, 1984

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Armando Vargas
Minister of Information & Communications
Costa Rica

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PACIFIC TELECOMMUNICATIONS NEEDS, DEVELOPMENTS, AND ACTIONS

Tetsuro Tomita
Deputy Director-General
Telecommunications Policy Bureau
Ministry of Posts and Telecommunications
Japan

Japan has established the second finest telecommunications system in the world by keeping and promoting a telecommunications policy of monopoly for about 30 years. Among the measures for monopoly are bond issues, low interest financing, relatively expensive equipment charges and tax exemption.

However, the disadvantages of the monopoly are being revealed these days. That is,

(1) the legal tariff system makes it difficult to lower the long-distance telephone charge,

(2) the prices of procured equipment are apt to be stabilized at a relatively high level,

(3) the introduction of new services or new media is apt to be retarded, and so forth.

Therefore, Japan is seeking to take a drastic step, in which NTT will be privatized and new entrants will be permitted at the same time. The new policy is expected to lead the activation of telecommunications activities and to stimulate the introduction of new services.

It is often said that introduction of competition is impossible for the developing countries with limited resources and Japan also was always on the safe side. Now, Japan is preparing to change its policy to introduce competition while accepting some uncertainty that there might be a risk of inefficiency and waste in some part.

Nevertheless, I believe that Japan's policy change will surely accelerate the development of telecommunications, not only in Japan, but also in the Pacific region.

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Vice-Chairman
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LIFE-STYLE ANALYSIS IN TELEPHONE MARKET

Ichiro Hashimoto
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Tokyo, Japan

1. Abstract

The era of tremendous increase in demand for and installations of telephone sets is over in Japan. Most subscribers now seem to be satisfied with the standard type of telephone. However, under this quiet surface, some new trends can be observed in the market. In order to be able to develop advanced telephone models, and to increase the range of usage, it is now necessary that these potential needs be grasped.

2. MARKET CONDITIONS

2.1 GENERAL MARKET CONDITIONS

After the age of high-economic growth in Japan (1960-1973), a new age seems to have come to the markets, not only in terms of consumer goods but also durable goods. The golden age of mass production and the mass market is over, and manufacturers as well as service providers have begun to realize that they cannot get along without a new marketing approach.

Some trends can be identified as characteristics of these new marketing conditions. In other words, a new profile of the current leading consumers is illustrated in the trends shown below.

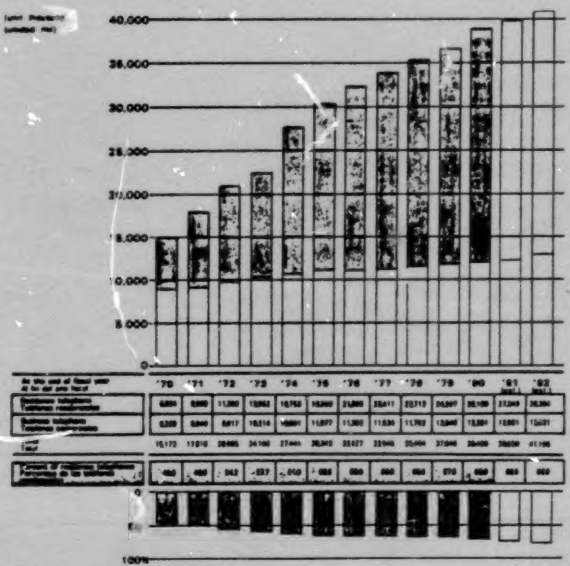
age '60s-the early '70s	the late '70s-now
1) upward drift of income	levelling off of income
2) diffusion of goods necessary for life	decrease in purchasing interest in "goods"
e.g. color TVs, automobiles, air conditioners, etc.	i.e. emphasis on "non-goods" services such as traveling abroad, sports, cultural or learning activities
3) demand for individuality in purchasing ("one point luxury")	demand for selected goods suitable to their "Life-Style"
4) mass-advertisement for mass-sales through mass-media	approaches to segmented consumers
	e.g. attention to the individualistic communication media such as graphic, local or special magazines
5) large-sized supermarkets	speciality stores

The trends shown above are not only for the consumption goods but also for the durable goods market, the latter including telephones. These are trends toward needs diversification or market segmentation. Without taking them into consideration together with other general market conditions, it will not be possible to carry out our business with the proper degree of success.

2.2 TELEPHONE MARKET CONDITIONS

Our telephone installation activity had reached a cross-roads with the end of high-economic growth marking the turning point. As the table quoted below shows us, the increase in the number of telephone subscriber lines in service had been slowing down. This tendency has become clear especially in business telephones as well as in residence telephones, where the growth rate for installed lines in service has been declining in last few years. This situation makes us to see the importance of fully utilizing all telephone lines already installed. This is especially true for residential telephones which number nearly 28 million.

Figure 1. Increase in Residence Telephones



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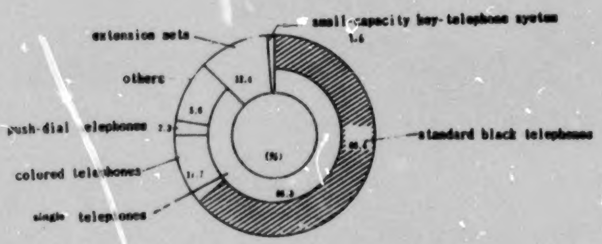
In most Japanese households, there is on average only one telephone connected with one line. Statistics show us that a plural number of phones are installed in U.S. households even though there may be only one line running into the house, as in Japanese homes. This example indicates the possibility of stimulating the apparently cooled off market by increasing the number of telephones per family.

In addition to the quantity side of telephone installation, the quality side also requires attention. As the list below shows, in spite of our sales efforts, the most popular residential telephone remains the standard black dial model which occupies a two-third share of the distribution ratio. On that point as well, the U.S. seems to have made advances. It is well known that many kinds of telephones are adopted throughout the house in accordance with the various needs to be found in home life in the U.S.A.

Figure 2. Market Share of Residential Telephones



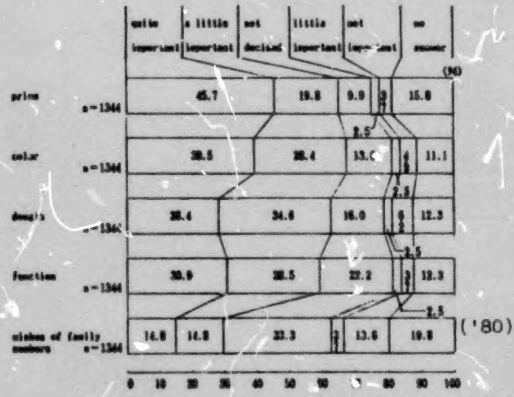
('80)

Not only our corporation but also private telephone manufacturers now offer many types of residential telephones, however up to the present, our marketing has gone largely unrewarded. In other words, the lineup of our products does not match demand from users. It is necessary for makers of residential telephones to grasp the real needs of users.

3. FOCUS OF THIS SURVEY

We carried out one survey to study current users' needs taking the market trend mentioned above into consideration. This survey was mainly done focusing on color and design, the most important factors in purchasing a telephone excluding price.

Figure 3. Important Factors in Purchasing a Telephone



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4.1 BACKGROUND TO THE SURVEY

The current market trends shown in section 2. have been developing steadily in the telephone market. In the preceding 1980 survey, the following became clear:

a. The basic movement in the residential telephone market is "personalization". The leading group of users wish to possess a telephone for private use. In order to realilze this personalization, it is indispensable to make new products correspond to the diversification of users' needs.

b. Through the repositioning analysis of products being provided now, it was shown that leading models which match current diversified needs are lacking in our lineup of products.

4.2 METHODOLOGY OF LIFE-STYLE ANALYSIS

Judging from our experiences of late, the "Demographic Analysis Method" does not seem to be as valid as the "Life-Style Analysis Method" as a means to identifying diversified needs for telephones.

The life-style analysis method attempts to analyse one's behavior or choice on the basis of internal human factors in contrast to the demographic analysis method that relys on one's external characteristics such as sex, age, occupation and so forth. Life-style analysis deals with personal factors like one's judgment, values, life attitudes, and consumption behaviour, and uses these as clues in analyzing one's reaction or attitute towards many types of questions. It also statistically works out certain basic concepts which constitute one's life style from these reactions or attitudes in the survey samples. People can be classified into a number of specific groups based on these fundamental concepts. Concretely defined ideas are formed from the diverse personal needs shown through an analysis of the characteristics of these groups.

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4.3 OUTLINE OF SURVEY

samples:	men & women over 15 years old
areas:	300 points throughout the country
main items of survey:	*communications *activities and feelings in daily life *consciousness of telephone use *possession and use of telephones *design concepts *characteristics of samples
method:	writing by respondents (ordinary interview was jointly carried out)
number of samples:	3,000 persons
period:	Oct. 1981 - Mar. 1982

5. RESULT OF SURVEY

5.1 BASIC CONCEPTS

In this survey, the three basic concepts described below were statistically deduced as the key items for grouping users based on their "consciousness of telephone use".

a. consciousness of enjoying the utility of the telephone

e.g.
"Telephones are very convenient. You can communicate with anyone whenever you want."
"I feel secure if I have a telephone near me when I am alone and sick."
"Telephone calls are a swift and effective method for doing business."
"Telephones help us stay close to our family members even though we may be apart.
"Communication is more lively and complete than with written messages."

b. consciousness of expecting inter-human (emotional) communication with telephone

e.g.
"One calls someone often only to kill time."
"One calls often only to hear someone's voice with no special purpose."
"The ring of telephone gives one a vague feeling of joy."
"Telephones widen one's circle of friends."
"Telephones make it possible to communicate more intimately than direct communication."
"Telephones are a part of the interior furniture."

c. consciousness of hesitation or reluctance to use the telephone.

e.g.
"Telephones are not very useful for delicate communication."
"One becomes somewhat more nervous about expression oneself when speaking on the telephone than in a face-to-face conversation."
"One sometimes hesitates to call fearing that the other party may not be available."
"The ring of the telephone gives one a vague feeling of uneasiness."
"Telephone communication often causes misunderstandings."
"One feels uneasy about the telephone calls that could not be answered in time."

5.2 GROUPING OF TELEPHONE USERS

According to the degree of the intensity of the reaction to these three basic concepts (horizontal items), the total samples were divided into the following five groups (vertical items).

Figure 4. Consciousness of Telephone Use

basic concepts / contribution ratio / name of group	consciousness of telephone use		
	various utilities	inter-human communication	hesitation or reluctance
	0.37	0.25	0.12
A. soft utility enjoyer	+	+	-
B. hard utility enjoyer	+	+	+
C. effectiveness utility enjoyer	+	-	+
D. basic utility enjoyer	+	-	-
E. indifferent user	-	*	*

+ positive reaction, - negative reaction,
*no reaction

5.3 PROFILES OF USER GROUPS

Residential telephone users can be divided into five groups on the basis of their life-styles. As has already been mentioned, this grouping was carried out on the basis of a survey of consciousness. These clusters can be regarded as segmented user groups, which can be dealt with separately in the real Japanese market. Each typical profile of these groups is as follows;

Figure 5. Profile of User Groups

name of group	profile of residential telephone users
A. soft utility enjoyer (14%) (private purpose)	1) unmarried or married women in 20s with a cheerful disposition 2) a sociable person 3) often calls intimate friends 4) tastes run toward modern, European and American style design 5) interested in goods that enrich her life-style
B. hard utility enjoyer (18%) (multi-purpose)	1) a university graduate of steady character 2) a person with a broad perspective 3) sociable as well as valuing their own private lives 4) wide range of social activity, frequent calls to friends 5) taste for high quality and neat design 6) emphasis on goods with high added value
C. effectiveness utility enjoyer (25%)	1) a person of high social status, taking a leading role in social activities 2) frequent telephone use for business, but not so often for private matters 3) puts much value on functions of telephone 4) taste for plain design 5) prudent attitute in purchasing
D. basic utility enjoyer (28%)	1) ordinary office worker 2) setting a high value on private life with a relatively small group of acquaintances 3) telephone use when needed 4) taste for practical design 5) low propensity for consumption
E. indifferent user (16%)	1) a young high-school graduate engaged in agriculture or fishery 2) disorganized life style 3) frequent calls without consciousness of telephone utility 4) no special taste for design

note: () represents percentages in total samples

5.4 TELEPHONE USAGE BY USER GROUPS

The actual telepone use status for each group is as shown in the following list. It is remarkable to see that while the "soft" and "hard utility enjoyers" are most conscious of the reasons why they are using the phone, and the "indifferent user" is the least conscious regarding telephone uses, both of them are frequent telephone users.

Figure 6. Telephone usage by User Groups

items of survey / name of group	telephone use condition		
	number of calls (per week)	object of calls	content of calls
A. soft utility enjoyer	7.2	friends in their intimate circle	conversation with no special purpose
B. hard utility enjoyer	6.9	members of family living separately	consultation (advice), conversation with no special purpose
C. effectiveness utility enjoyer	4.4	members of family living together	daily communication inquiries

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D. basic utility enjoyer	5.3	members of family living separately	report on current affairs
E. indifferent user	6.7	unspecified number of people	nothing particular

5.5 DESIRE FOR EXCLUSIVELY PRIVATE TELEPHONE

Desire for exclusively private telephones in each group is as follows. "Soft" and "hard utility enjoyers" are the groupings most eager to have their own telephones. They will lead the way in the coming private phone market. Portable telephones will be favored by the "soft utility enjoyer" group.

Figure 7. Desire for Private Telephone

items of survey / name of group	exclusive private telephone		
	Desire for installation (%)	type (%)	
		portable	jack(plug)
A. soft utility enjoyer	26.5	47.2	32.0
B. hard utility enjoyer	21.7	35.3	38.3
C. effectiveness utility enjoyer	11.8	33.3	37.9
D. basic utility enjoyer	12.4	30.1	40.8
E. indifferent user	6.2	27.6	37.9

Continued on the following column.

items of survey / name of group	exclusive private telephone					
	color (%)					
	white	ivory	red	blue	black	gray
A. soft utility enjoyer	22.4	21.6	15.2			
B. hard utility enjoyer	26.7	27.6		7.8		
C. effectiveness utility enjoyer	24.1	23.0	17.2			
D. basic utility enjoyer	20.4	33.0			9.4	
E. indifferent user	34.5	27.6				10.3

In every group, a desk telephone was first and a wall telephone was preferred second.

5.6 DESIGN CONCEPTS

After analysis of the responses to our inquiry, design concepts having the greatest strentgh in the future telephone market are deduced to be as follows.

1) humorous, dreamy, fanciful, lovely
2) showy, luxurious, deluxe, high-class
3) simple, intellectual, smart

Reactions or attitudes of each group toward these concepts are surveyed and ideal or desirable design images for each group are described as follows;

Figure 8. Attitudes toward basic Design Concepts

items of survey / name of group	basic design concepts		
	humorous dreamy lovely	showy deluxe high-class	simple intellectual smart
A. soft utility enjoyer	+++	++	+++
B. hard utility enjoyer	++	+++	++
C. effectiveness utility enjoyer	+	-	+++
D. basic utility enjoyer	-	++	-
E. indifferent user	-	-	-

note: +++ strongly agreed, ++ agreed, + agreed a little, - not agreed.

Continued on the following column.

items of survey / name of group	basic design concepts			desirable design images
	sex	mechanical manly	elegant ladylike	
A. soft utility enjoyer	m.	+++	-	dreamy fanciful, simple, somewhat high-class
	f.	-	++	
B. hard utility enjoyer	m.	+++	-	high-class smart
	f.	-	++	
C. effectiveness utility enjoyer	m.	-	-	simple intellectual, somewhat dreamy, fanciful
	f.	-	+++	
D. basic utility enjoyer	m.	-	-	practical, plain somewhat high-class
	f.	-	+++	
E. indifferent user	m.	-	-	no special design image
	f.	-	++	

note: +++ strongly agreed, ++ agreed, + agreed a little, - not agreed.

It has been clearly shown by another analysis that the leading groups, "soft" and "hard utility enjoyers" are not content with the existing telephones on the current market.

6. VIEWING THE FUTURE

Through this survey, we were able to get a clear overview of users' needs. New product planning for residential telephones is now underway in our corporation, and the results of this survey are being utilized. The current movement toward diversification and personalization gives every indication of continued strength in the telephone market of the near future. The lesson here for us is that we must be more careful about users' needs and respond to them accordingly.

It will be necessary hereafter to develop an appropriate and practical method to identify the life-styles of individual users, and to establish designs that will appropriately fit the life-style of each particular group.

Satellite Communications Equipment Manufacturing in Developing Countries

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1. Abstract

This paper emphasizes the importance and present ideas for the participation of developing countries in the planning and manufacturing of their satellite communication systems. A strategy to stimulate manufacturing of local satellite communications equipment is presented considering the planning and industrial experience obtained in Mexico.

2. INTRODUCTION

Satellites have demostrated to be a cost effective alternative for a variety of telecommunication services, due to this developing countries are including them in their plans for expansion of their telecommunication systems. Distribution of TV and long distance telephony are the primary uses of satellites in developing countries, but rural telephony and educational TV through direct broadcast from space are applications with great appealing due to their expected social impact.

At present several countries are leasing transponders from existing satellites mainly from INTELSAT, or are planning to acquire their own satellites for domestic communications, and important financial resources have been allocated for this purpose.

Unfortunatelly, most developing countries have great technological dependency on foreign sources not just at equipment manufacturing level, but also at the system definition and planning level. This dependency is so strong that in most cases turn-key systems are acquired without any, or minimum, local participation in the design, planning and manufacturing.

A domestic satellite system represents a unique opportunity to develope a local industry sustained by a large domestic market for satellite communication equipment. But in order to make use of this opportunity, it will be necessary a careful planning of the satellite system based on national requirements and to define a strategy to stimulate the local industry.

Based on our experience in Latin American countries, we present in this paper a strategy to develope the local industry in the framework of a domestic satellite system.

3. PLANNING THE SATELLITE SYSTEM

In most developing countries the telecommunication system is owned by the government or by a monopoly controlled by the government. This makes possible the use of the telecommunication system as a mean to stimulate the development of the country as a whole.

The capability of a satellite system for multiple access makes it ideal to share the revenues from highly profitable services, long distance telephony and comercial TV, with social applications of the satellite technology, rural telephony and educational TV. Being the government the owner of the satellite system and also its main user, the planning of this system, the ground and the space segments, could be done to satisfy the national goals in the most effective way. Figure 1 illustrates a general methodology for the planning process. The optimizing criteria is generally the minimum cost of the total system, the sum of space and ground segment cost. We propose in this paper that the participation of local industry must be used as an additional constraint to the process of Figure 1.

The definition of local industry participation requires an analysis of the degree of development of the electronic industry within the context of a satellite system. In this way, the choice of parameters like effective radiated power (EIRP), saturation power density, modulation and frequency could be related to the manufacturing capability of the local industry.

To analize the different alternatives that are possible, the process of Figure 1 becomes fairly elaborate making advisable to use computerized aids to speed up the planning. In this way the planner will be free from the complexity of satellite link, and other repetitive calculations permitting him to concentrate better in the general view of the problem and the actual planning tasks. Telecommunication agencies in most developing countries have computer centers and competent personnel capable of developing their own planning aids with a minimum of outside help. Figure 2, shows the main components of SATEL a computerized model developed in Mexico (1).

In some latin american countries, and other developing nations, already exist a manufacturing capability to produce radio equipment up to UHF frequencies (see for example (2)) and only and incipient capability to manufacture microwave equipment. It is obvious then that at present the local industry can only play a role in the manufacturing of the most simple type of ground stations, TV receive only (TVRO) and rural

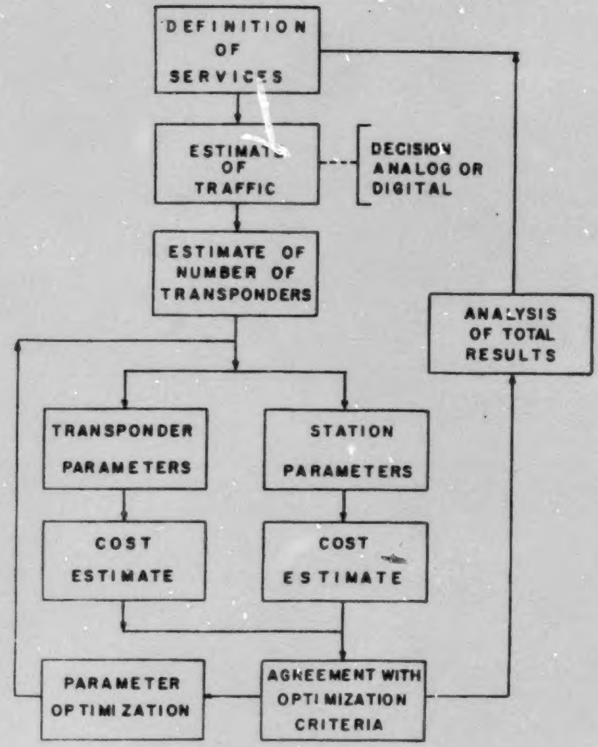
DEFINITION OF SERVICES
ESTIMATE OF TRAFFIC
DECISION ANALOG OR DIGITAL
ESTIMATE OF NUMBER OF TRANSPONDERS
ANALYSIS OF TOTAL RESULTS
TRANSPONDER PARAMETERS
STATION PARAMETERS
COST ESTIMATE
COST ESTIMATE
PARAMETER OPTIMIZATION
AGREEMENT WITH OPTIMIZATION CRITERIA

FIGURE I

SATELLITE COMUNICATIONS SYSTEM PLANNING

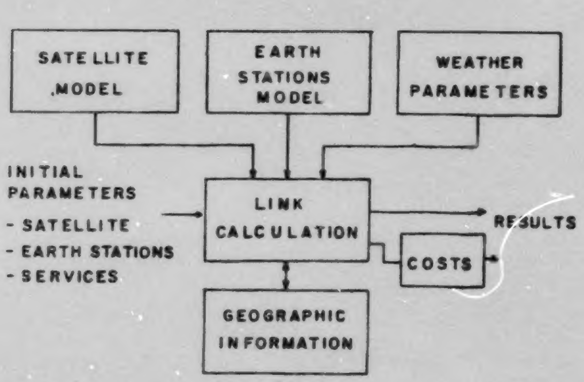
SATELLITE MODEL
EARTH STATIONS MODEL
WEATHER PARAMETERS
INITIAL PARAMETERS
- SATELLITE
- EARTH STATIONS
- SERVICES
LINK CALCULATION
RESULTS
COSTS
GEOGRAPHIC INFORMATION

FIGURE 2

SATEL SYSTEM FUNCTIONAL RELATION

telephony stations. Therefore, it will be necessary to choose the satellite parameters to obtain the required simplicity of rural and TVRO stations that will permit the participation of the local industry. It is interesting to note that rural and TVRO stations represent a potentially large and attractive market. Table I shows an estimated market of stations in Mexico, this table includes only those stations that are likely to be bought by the Mexican Government.

TABLE 1

POTENTIAL MARKET FOR EARTH STATIONS IN MEXICO

QUANTITY	TYPE OF STATIONS
16	Major Stations for Long Distance Telephony
1600	Small SCPC Stations
1000	TVRO Stations for Schools
65000	Roof top TVRO Stations for Schools

4. STATION SIZE AND COMPLEXITY

Rural stations in developing countries require from 1 to 4 telephony channels, see for example the case of Mexico and Peru in (3) and (4). The antenna size of a small station is mainly limited by the satellite orbit separation, the minimum practical size for the frequency band of 4/6 GHz is about 4.5 m. The modulation scheme that provides the simpliest configuration is SCPC/FM.

The antenna size of TVRO stations is a direct function of the EIRP of the satellite. In the frequency band of 4/6 GHz this EIRP is restricted to minimize interference into the microwave network that uses the same band. The EIRP should be such, that in the worst case, elevation angle less than 5°, the flux density should not exceed -152 dBw/M^2/4KHz. This sets the minimum antenna size to approximately 3m for a typical FM-TV transmission, assuming a LNA noise temperature of 120°K.

In the 12/14 GHz band a broadcast service from space is possible since satellites are allowed to transmit at very high levels, at EIRP more than 53 dBw. These levels are compatible with roof top antenna sizes, less than 1 m. At this sizes the market is expected to grow substantially due to the dramatic drop in price of the earth stations, which is expected to be approximately the same as the cost of a regular TV receiver, (5). In Mexico alone there was more than 5 million of TV receivers in 1975.

5. GENERAL STRATEGY FOR SATELLITE COMMUNICATIONS EQUIPMENT MANUFACTURING IN DEVELOPING COUNTRIES

In order to manufacture satellite communication equipment it is necessary to have a basic telecommunication industry sustained by proper human and financial resources. Even in those developing countries in which financial resources are found,

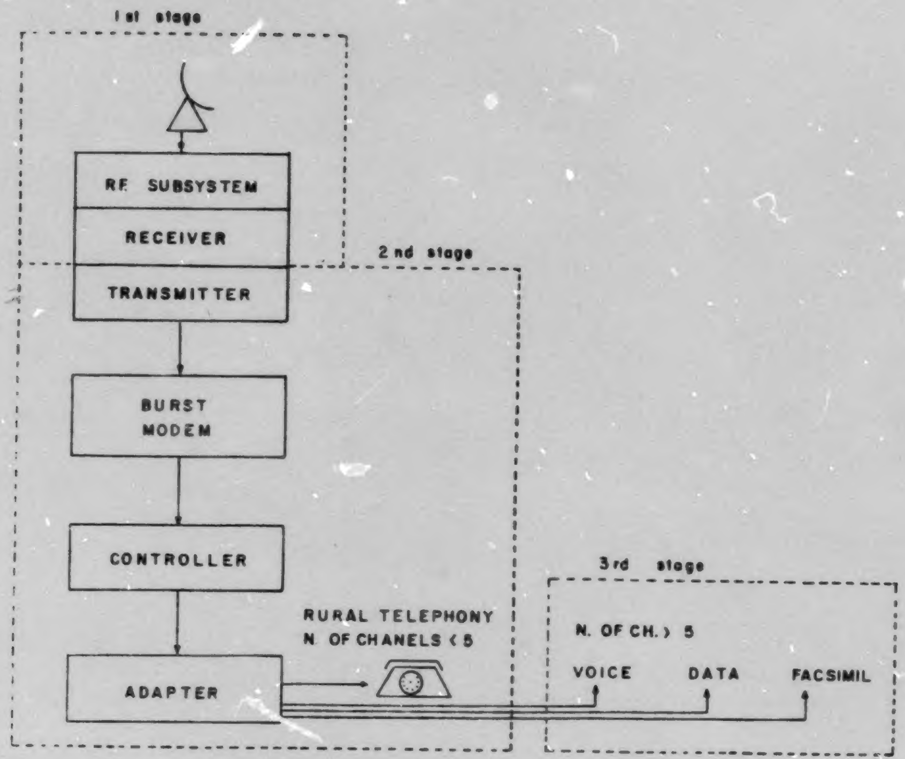
1st stage
RF SUBSYSTEM
RECEIVER
TRANSMITTER
2nd stage
BURST MODEM
CONTROLLER
ADAPTER
RURAL TELEPHONY
N. OF CHANELS < 5
3rd stage
N. OF CH. > 5
VOICE
DATA
FACSIMIL

FIGURE 3
SUGGESTED SATELLITE EQUIPMENT MANUFACTURING IN DEVELOPING COUNTRIES

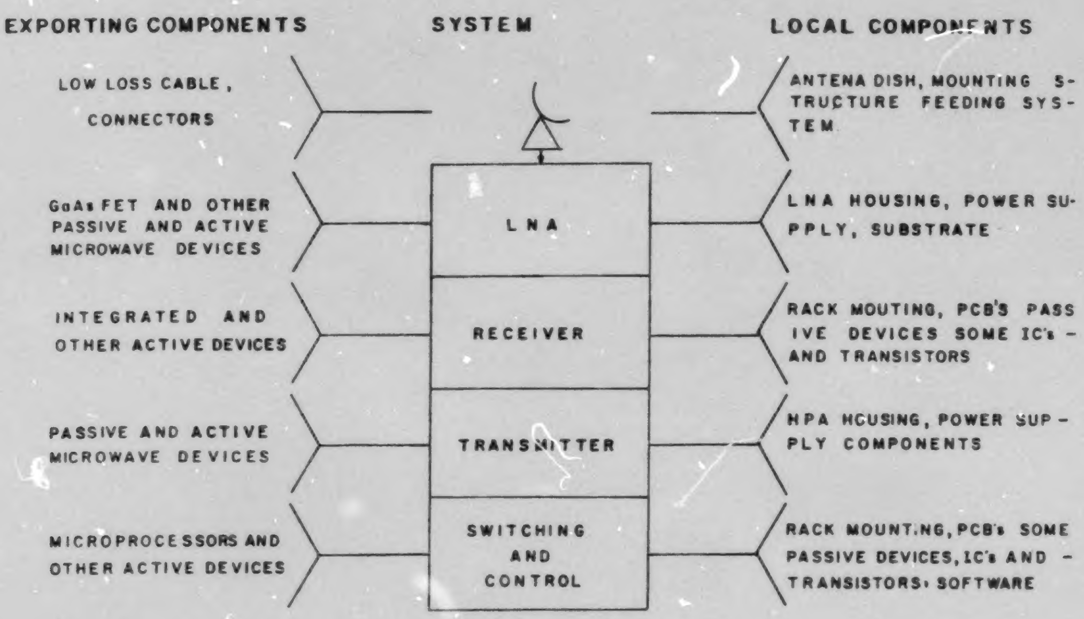
EXPORTING COMPONENTS
SYSTEM
LOCAL COMPONENTS
LOW LOSS CABLE, CONNECTORS
ANTENA DISH, MOUNTING STRUCTURE FEEDING SYSTEM
GaAs FET AND OTHER PASSIVE AND ACTIVE MICROWAVE DEVICES
LNA
LNA HOUSING, POWER SUPPLY, SUBSTRATE
INTEGRATED AND OTHER ACTIVE DEVICES
RECEIVER
RACK MOUTING, PCB'S PASSIVE DEVICES SOME IC's AND TRANSISTORS
PASSIVE AND ACTIVE MICROWAVE DEVICES
TRANSMITTER
HPA HOUSING, POWER SUPPLY COMPONENTS
MICROPROCESSORS AND OTHER ACTIVE DEVICES
SWITCHING AND CONTROL
RACK MOUNTING, PCB's SOME PASSIVE DEVICES, IC's AND TRANSISTORS, SOFTWARE

FIGURE 4
SYSTEM INTEGRATION SCHEME FOR TVRO AND RURAL TELEPHONY EQUIPMENT MANUFACTURING

manufacturing process of electronic equipment is oriented basically towards consumer goods. At present time, not all developing countries would be capable to start a manufacturing process at the technological level that is required in satellite communication systems. Under this situation, the manufacturing process of satellite communications equipment in a developing country faces several constraints, some of the most important are: Strong dependency of semiconductor devices and integrated circuits and subsystems, lack of specialized human resources, and high cost of R.F. and base-band manufacturing and testing equipment. Related to these constraints, it can be added a severe economic contraction that impacts, on the potential estimated market. On the other hand, there are several benefits obtained when local manufacturing capability is achieved. Some of these benefits are: Improvement of Import/Export relation, generation of Know-How related to design and production of high technology electronic equipment and development of specialized human resources at the industrial and academic level.

In developing countries, the participation of research and development institutions during the different stages of satellite equipment manufacturing is fundamental and it will be necessary to establish a link between these academic institutions and the industrial sector in order to develope the Know-How and manufacturing capability that is required.

Careful specification and identification of the components and subsystems of a global system that can be manufactured in the country is a very important matter. This identification process has to be realized taking into account the particular human and material resources of the country to estimate the total import component necessary for the final integration of the system (2).

Due to its relative present technological complexity, TVRO equipment manufacturing can be considered as the initial stage of a satellite communication equipment manufacturing effort in a developing country. The basic parameters of the reception system will be fixed according to the system planning and the associated satellite characteristics. In the case of Mexico, the satellite will have C and Ku band transmission, therefore, development of C band receivers has been considered as a first manufacturing approach. Ku band equipment has more relative technological complexity, however, the experience obtained at C band will give pace to Ku band development in a natural way (see Figure 3).

At this present time there is not a developing country that produces microwave solid state devices (GaAsFET with 0.5 micron gate for example) or advanced integrated circuits (VLSI circuits). All these elements have to be imported, however, antenna, mounting structure, printed circuit boards, rack structures which could be manufactured locally, added to cheaper labor costs could have a great impact on total production cost of the earth station system. In order to exemplify possible TVRO manufacturing, a system integration scheme that includes rural telephony equipment as a following stage is shown in Figure 4. This sheme would be modified according to the particular characteristics of a given country. In cases like Brazil, Argentina, Venezuela and México which have comparable telecommunications infraestructure the scheme will not vary significantly. However there will be countries in the African, Asian or Latin American region in which

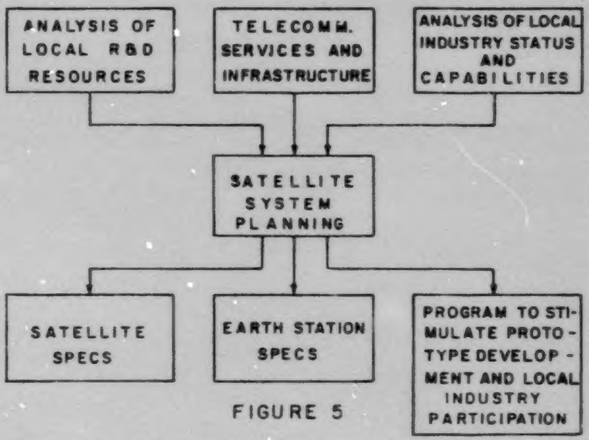
ANALYSIS OF LOCAL R&D RESOURCES
TELECOMM. SERVICES AND INFRASTRUCTURE
ANALYSIS OF LOCAL INDUSTRY STATUS AND CAPABILITIES
SATELLITE SYSTEM PLANNING
SATELLITE SPECS
EARTH STATION SPECS
PROGRAM TO STIMULATE PROTOTYPE DEVELOPMENT AND LOCAL INDUSTRY PARTICIPATION

FIGURE 5

INPUT-OUTPUT INFORMATION OF SYSTEM PLANNING FOR LOCAL MANUFACTURING

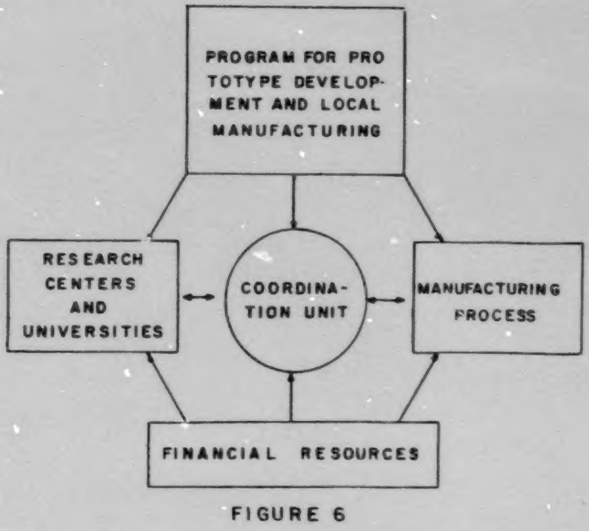
PROGRAM FOR PROTOTYPE DEVELOPMENT AND LOCAL MANUFACTURING
RESEARCH CENTERS AND UNIVERSITIES
COORDINATION UNIT
MANUFACTURING PROCESS
FINANCIAL RESOURCES

FIGURE 6

STRATEGY FOR LOCAL PARTICIPATION IN SATELLITE COMMUNICATIONS EQUIPMENT MANUFACTURING hardly any ground station manufacturing task could be carried on. In these cases the approach could be to establish assemply factories in which cheap labor cost is the most important parameter.

6. PROGRAM FOR SATELLITE COMMUNICATIONS EQUIPMENT MANUFACTURING

Considering the information shown in Figures 3 and 4, and taking into account the basic telecommunications industry of a given developing country as well as its local human and material resources, a strategy for satellite communications equipment manufacturing is presented in Figure 5. This figure shows the suggested steps for local manufacturing in developing countries.

Three main inputs are considered in Figure 5: Analysis of local R & D resources, Telecommunication services and infraestructure and analysis of local industry (status and capabilities). Then, through proper system planning, satellite and earth station specs are obtained. A very important output of such planning process, is the definition of a program to stimulate prototype development and local industry participation.

A possible program to stimulate prototype development and industry participation is shown in Figure 6. In this program, the communication satellite system definition obtained in the system planning stage is given simultaneously to Research Centers and Industries. In order to work together (The Industry and Research Centers) under a cooperative scheme a coordination unit is considered. This unit will act as a liason and also as a channel of information among the entities involved in the manufacturing process. In some developing countries as in the case of Mexico the coordination unit could be runned by the government. At present the National Council of Science and Technology of Mexico has a program called The Sharing Risk Enterprise (6) in which the prototype development is financed by both the industry and the council. The Universities and/or Research Centers have the responsability of prototype development with direct supervision of the industry in which the manufacturing process will be carried out. The coordination unit will not be necessarily a government agency, but most important is to achieve the required coordination aspects of the manufacturing effort.

Considering that the necessary time to build a domestic kind of satellite is around three years, there is ample time to implement the strategy for the participation of local industry in the manufacturing of satellite communications. Table II shows time schedule for TVRO development in which the satellite construction time and launching is considered as the time reference pattern.

TABLE II

A PROGRAM FOR TVRO STATION

	YEARS			
	1st	2nd	3rd	4th
System planning	—			
Prototype development	—	—		
Optimization and testing		—		
Manufacturing process		—	—	
Instalation of ground stations			—	—
Initial stage of satellite operations			—	—

7. CONCLUSIONS

There are some developing countries in which turnkey systems are installed and the only local participation is found at the systems operation level. In this case a severe technological dependency is created. As long as any local participation in the manufacturing task is not stimulated, a greater technological gap in the increasingly challenging telecommunications field will be developed.

It is possible to avoid a total technological dependency and to open a path to industrial development in the satellite communication field if proper planning of the satellite system is performed. This planning effort should take in consideration the limitations of the local industry to choose the parameters of the satellite system.

The planning process should have as one of its main outputs a program to stimulate local Industry and Research Institutions and Universities to work in coordination towards design and production of defined satellite communication subsystems.

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Session 2

Needs for Telecommunications in Rural Communities

SATELLITE TELECOMMUNICATIONS FOR DEVELOPMENT: THE A.I.D. RURAL SATELLITE PROGRAM AND ITS PILOT PROJECTS IN INDONESIA, PERU, AND THE CARIBBEAN

Clifford Block, Douglas Goldschmidt, Anwar Hafid,
Gerald C. Lalor, and Angel Velasquez (1)
AID Rural Satellite Program

1. ABSTRACT

A pilot program to aid the developing world in testing the use of satellite telecommunications for rural development is now in its fourth year. Experience gained in the pilot projects of the AID Rural Satellite program--in Indonesia, Peru, and the West Indies--points out the institutional, technological, financial, and applications issues that should be taken into account by nations in the Pacific and other regions in implementing such projects.

2. BACKGROUND

The Rural Satellite Program of the Agency for International Development (AID) represents a natural and logical next step in AID's exploration of the potential of satellites for use in development. This extraordinary technology, which has gone from revolutionary to commonplace, from idea to a world-wide service in less than 40 years, has appeared to many during that time to answer a basic need of less-developed countries: unifying and community-serving communications without the enormous costs of building a terrestrial infrastructure. Despite this obvious appeal, for the most part developing-country use of satellites for development purposes has been almost entirely experimental. NASA's ATS series of satellites has provided most of the opportunities: India's SITE experiment, AID's 1976 AIDSAT demonstrations with 27 countries, PEACESAT, and USPNET.

By 1979 it had become clear that serious obstacles to wide utilization of the potential of satellite communications for rural development still remained:

- Models of successful uses were still too few, too poorly funded, and too little visible to serve as a basis for decisions on wider adoption.
- Investment sources such as the World Bank and the regional banks had not seen enough evidence that satellite systems could be cost-effective in achieving equitable rural development.
- INTELSAT did not believe it worthwhile to provide services optimally designed for rural areas, either in capacity, ease of access, or tariff structure.
- Manufacturers of earth stations saw no viable market in developing earth stations of a size, power level demand, or price appropriate to rural needs.
- Most developing countries lacked the planning capacity and the commitment in their communication sectors to deal with the new requirements inherent in such a development.

The AID Rural Satellite Program was undertaken with the full realization that there were formidable obstacles, some of which might not yield to the efforts of a six-year program; and that the successes--or failures--in reaching the objectives would be influenced by factors outside the control of the project.

On the other hand, Indonesia was already operating its own Palapa satellite, although with only slight emphasis on rural development; India was preparing to proceed with INSAT; other nations and groups of nations were actively exploring possibilities of national or regional service. The significance of modern communications seemed to be growing exponentially in the developing world, and if the objectives proposed could be met, the contributions might be of major importance.

Thus, in 1979, AID made the decision to begin an exploratory program to aid the developing world in testing the use of satellite communications for rural development. The experimental aspect of the program is not in the equipment, although certain hardware innovations are a part of the program; rather, the experiment is with the applications. It is a program designed to see how effectively key development initiatives can use this new communications capacity, and whether such use can spur development sufficiently to warrant larger-scale programs.

A decision was made to concentrate on interactive, narrow-band telecommunications, rather than the broadcast, community television mode of experiments such as SITE. The Pacific experience with two-way communications in PEACESAT and USPNET, and Alaska's two-way health communications network were encouraging. AID had begun support of USPNET (which still continues) and was impressed with the power of audio conferencing in that system when incorporated fully into an institution's operation. Furthermore, the provision of basic telephone service in rural areas as an instrument for rural economic development needed to be tested. Community TV-broadcasting can be an important social development tool; it is simply not the focus of this project.

AID also decided to use existing satellite services--INTELSAT and Palapa, notably--rather than to plan for some new satellite capacity. Even though INTELSAT is not optimized for the lowest-cost earth stations, it is clear that commercial satellite services do evolve, and it was AID's intention to assist that evolution toward more optimum services.(2)

The key to the program was the development of pilot projects that could test out, in realistic rural situations, the use of satellite telecommunications. The Rural Satellite Program is supporting three two-year demonstrations described below; two of these are in the Pacific Basin--Indonesia and Peru--and one in the Caribbean. It is anticipated that all of these projects will leave behind the capabilities of maintaining ongoing operational services. An African project is on hold.

In addition, the Rural Satellite Program has been participating in a long-range cooperative working group on low-density earth stations with INTELSAT, NASA, and the Institute of Telecommunication Sciences (ITS) of the Department of Commerce, which has had the objective of ultimately lowering earth station costs. Under an interagency agreement with AID, ITS has produced a parametric study of earth station requirements and is presently developing a prototype station of low cost and low power, which might ultimately be producable for under $50,000. While these developments have produced no dramatic breakthroughs, it is clear that new digital technologies are bringing costs down steadily and significantly. It is possible that all that would be required to make the cost breakthrough would be investment in a large enough number of earth stations.

AID is also engaged, as are others, in a continuing policy dialogue with INTELSAT on the design of appropriate services and tariffs for thin-route service within developing nations. In this respect, INTELSAT's recent new service decisions are extremely encouraging.

Meanwhile, it is clear that, in developing countries, many earth stations would be placed in areas beyond the reach of the electric grid. The earth station requirement of low electric power level is premised on such situations and will require an alternative energy source. AID's Energy Office, through NASA, has contracted with Hughes Aircraft for a prototype solar power array to power a small earth station (drawing less than 500 watts) for the Indonesia project.

The major thrust of the Rural Satellite Program, however, is not in the area of hardware, but in the pilot projects that explore and demonstrate the boundaries of application. These are described in the following sections.

3. USING SATELLITES FOR HIGHER EDUCATION IN INDONESIA

3.1 INTRODUCTION

Indonesia's Palapa satellite system, in place since 1976, has until now been used largely for conventional commercial telephony, telex, and broadcasting, with few special social service offerings. The formidable engineering and management tasks involved with the extraordinary expansion of Indonesia's telephone system have fully absorbed the Indonesian telecommunications company, PERUMTEL.

During the Palapa system's planning in the early 1970s there was strong interest in using the satellite system to support national development activities, quite apart from the major benefits that would accrue from instituting reliable national telephone and broadcasting service. While this interest was not turned to practice in the early stages, PERUMTEL, a number of development-oriented ministries, and AID maintained interest in seeing Palapa used to support national development activities.

The Palapa satellite offers unusual opportunities for extending development communications. It is a high-powered regional system: small, inexpensive earth stations can be used, offering the eventual possibilities of widespread development of communication services in the most remote areas of the archipelago. Today there are 40 10-meter earth stations and 85 5-meter earth stations providing telecommunication services to most of Indonesia's vast population, and service areas are growing steadily. There is also a significant television distribution network. The satellite system makes a point-to-multipoint teleconferencing system relatively easy to implement. Furthermore, PERUMTEL has a large staff of skilled engineers and technicians who can support the technical requirements for specialized telecommunications applications.

However, Indonesia has had few institutional ties between its telecommunications authority and social development ministries such as health, education, agriculture, and economic planning. Traditionally, these ministries' only contact with PERUMTEL has been for basic telephone service. The practice of collaborating in the design of specialized telecommunications services has not developed, and the development ministries have generally not been knowledgeable about the options offered them by the satellite.

3.2 DEVELOPING EDUCATIONAL APPLICATIONS

After some years of analyzing alternative applications and working out institutional arrangements, an agreement for AID assistance was signed in 1981 for a program to enhance higher education. This focus was chosen to support new universities that have few resources and to provide a prototype for distance education activities which might be used as one component of a model for the development of the proposed Indonesian Open University. The number of students attempting to enter the university system is already overwhelming, and increasing yearly. An innovative approach to meeting higher education needs within limited financial and faculty resources has to be found, and using the Palapa system seemed one possible component of a solution.

With substantial support from AID, the Ministry of Education and Culture has been developing consortia of universities as a means of strengthening some of the smaller universities outside of central Java. Such consortia are under development in Sumatra, Southern Java, and the Eastern Islands. The first of these, the Eastern Islands University Association, or "BKS", is a consortium of 10 new universities located on the islands of Kalimantan, Irian Jaya, Seram, and Sulawesi. (BKS, Badan Kerja Sama, means "group working together.") The location of the BKS schools can be seen in Figure 1.

The BKS was organized to further the development of higher education, particularly in agriculture, among these relatively small and isolated universities. These schools have had persistent problems with faculty shortages, inadequately trained faculty, weak administration, and poor research and library facilities. The use of the satellite system to support teaching, administration, and other university activities was seen as a major boost to the capabilities of the schools. In addition, the satellite system was seen as a means of improving the connection of these schools with centers of excellence, such as the Institute of Agriculture-Bogor (IPB), and with centers of administration, specifically the Ministry of Education in Jakarta. Thus the AID-BKS project was designed to link 10 campuses of the BKS (two sharing one classroom), the IPB, the Ministry of Education, and a remote site (discussed below).

The following programs were selected for attention using the satellite system:

3.2.1 DISTANCE TEACHING

The shortage of specialized faculty, particularly in the basic sciences and in certain areas of agriculture, has meant that certain courses are taught by unskilled faculty members, and that visiting faculty are called in to teach specialized courses. The latter are often not available, or if they are it is only for one or two weeks at a time. They then teach a semester course in two weeks, and participating students must drop all other courses for that period. The results are not satisfactory and the costs are high. The satellite program will allow experimentation with distance teaching--that is, with a faculty member at one location offering fully interactive classes to students located in classrooms at other universities.

3.2.2 FACULTY TRAINING

Indonesia has had difficulties resulting from the minimal training that college teachers receive in teaching methods. A program to upgrade teaching skills, the AKTE-V program, relies primarily on face-to-face tutoring, as well as on print materials. The Ministry of Education believes that distance instruction is necessary to augment this program by providing continuing training for the tutors.

3.2.3 ADMINISTRATION

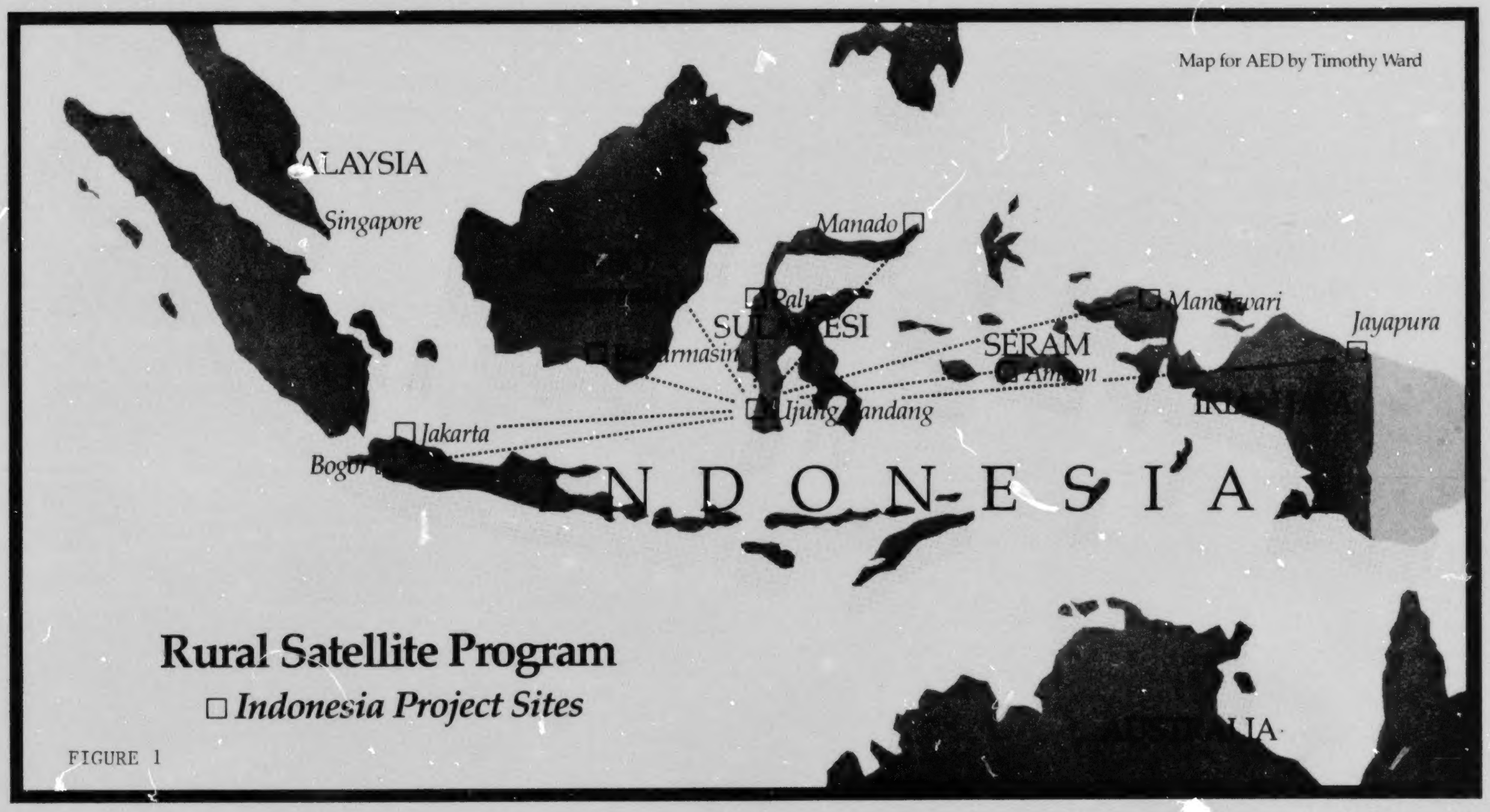
The development of the BKS has been hindered by the difficulty of communications among the administrators, deans, and faculty of the member schools, as well as with Jakarta. While rectors of the member schools meet several times a year, arrangements for the detailed coordination necessary to develop the BKS--designing common curricula, standardizing requirements, and the like--have been hampered by the expense of having members of various BKS committees traveling around Indonesia. The introduction of a teleconferencing system, particularly one which could also transmit documents useful in administration, was seen as an important step toward improving university administration.

3.2.4 RESEARCH AND LIBRARY DEVELOPMENT

Researchers and students within the BKS have minimal library facilities on their campuses, and the major agricultural research library in Bogor is too far away for easy access. A communication system is seen as useful both for allowing regular contact among colleagues through teleconferencing, and for the facsimile transmission of journal articles and reports from the main library in Bogor to each of the campuses.

3.2.5 REMOTE EXTENSION

Each of the BKS campuses has responsibility for providing educational services to rural development sites in its province. Such extension has been difficult to execute and support due to the remoteness of the project sites. The opportunity to extend the university's reach using communications is an interesting possibility. Such means of extending communications to very remote areas is


Map for AED by Timothy Ward
MALAYSIA
Singapore
Manado
Palu
SULAWESI
Banjarmasin
SERAM
Ambon
Manokwari
Jayapura
Ujung Pandang
Jakarta
Bogor
INDONESIA
IRIAN
AUSTRALIA

Rural Satellite Program

□ *Indonesia Project Sites*

FIGURE 1

also of interest to other agencies concerned with rural development, and to PERUMTEL.

3.3 TECHNICAL DESIGN

The technical design for the BKS system was driven by the following concerns:

- Applications requirements: The design had to meet the educational purposes previously defined, yet be flexible enough to accommodate changing university requirements.

- Cost efficiency: Because the system was being constructed to demonstrate how higher education and other development functions might be organized in the future, the system design had to be cost efficient in both capital and operating costs.

- Ease of use: The system could not require a large number of technicians for its operation. It had to be operable by university faculty with minimal technical training.

- Durability: The equipment had to be able to operate over extended periods in relatively hot, dusty, and humid environments.

- Decentralized operation: Given the ways the Indonesian universities operate, a centralized control center was not seen as desirable. Thus, the system design had to assure fully decentralized system use (as with a telephone system), with central administration.

After a good deal of joint planning with the BKS and a considerable review of existing teleconferencing media, the following technologies were chosen for the electronic classrooms:

3.3.1 AUDIOCONFERENCING

The basic teleconferencing capability in each of the main classrooms is provided by twelve microphones, two speakers, and a Darome convener. The system has been modified to diminish damage from moisture getting into the electrical contacts.

3.3.2 AUDIOGRAPHICS

Graphics support appears to be important to facilitate distance teaching. Two types of systems were reviewed--slow-scan television and a number of "electronic blackboards." In comparing them, we found that slow-scan television allowed for a broad range of graphics, but the electronic blackboards proved far more effective for displaying conventional writing, which was seen as a priority by the Indonesian educators.

The system developed by the British Open University, previously called "Cyclops" and now marketed by the Aregon Corporation, was chosen. This system allows full interaction among the project sites by enabling students and faculty to write on television monitors or graphic tablets with light pens. Transmission is over conventional telephone lines. In addition, the Aregon system offers a production facility where computer graphics (such as maps and graphs) can be created. These graphics are created, stored, and then transmitted to the project sites using audiocassettes playing into conventional telephone lines.

The Aregon units are now being tested to assure that the software, which was developed for small tutorials, will be adequate for teaching large groups of students. In addition, extensive training on the equipment is being undertaken in the U.K. and Indonesia to ease the adoption. Given the relative uniqueness of this technology, a detailed performance evaluation will be undertaken. The Aregon system will be further augmented through the use of video cassette recorders located in each classroom.

3.3.3 DOCUMENT TRANSMISSION

Document transmission was also felt to be highly desirable; therefore, automatic facsimile machines will be installed at each project site. These machines--the Burroughs Model 2102, a Group II analog machine--will allow documents to be sent to other sites with the machines unattended. The Burroughs machines were chosen because of their low cost, relatively fast transmission speeds (less than 100 seconds per page), and use of flat-bed scanning, reducing the number of moving parts which could be affected by the environment.

A key application of the facsimile machines will be sending documents from one point, generally Jakarta, to all of the project sites without having to repeat the transmission for each site. Such point-to-multipoint facsimile is still not perfected. However, a compromise solution will allow broadcast facsimile by automatically eliminating the return synchronization signal from all but one facsimile machine in any broadcast transmission. This will alleviate a major problem of facsimile broadcasting--accommodating multiple-sync signals. However, there is the danger that there will be a degradation of facsimile output due to faulty synchronization. This is an area where extensive experimentation will be carried out.

3.3.4 SYSTEM CONTROL AND ADMINISTRATIVE CONFERENCING

To accommodate the need for administrative conferencing, which will often involve only one person at each site, and where privacy is required, additional equipment was designed which will allow individual project sites to be signaled, and, when connections are established, a lockout signal will prevent anyone else from entering into the conference. The equipment used for the administrative conferencing will also provide network control by providing signalling, circuit bridging (for creating duplex circuits) and lockout functions.

3.3.5 REMOTE COMMUNICATIONS

The extension to remote areas will be accomplished using a small earth station, approximately five meters in diameter. This earth station will be powered by a photovoltaic array, designed for AID by NASA. As a result, power consumption had to be minimized to allow the economical use of the solar cells. This has been largely accomplished by drastically reducing environmental controls like air-conditioning and lighting, so that total power consumption will be 500 watts. PERUMTEL and AID will be studying this earth station's performance carefully to determine whether it can act as a model for other rural communication extensions.

3.3.6 TRANSMISSION SYSTEM

To assure economical system transmission, existing PERUMTEL earth stations will be used at all project sites except the remote site. Access to the earth stations will be through two pairs of dedicated four-wire lines from each project site. Four-wire connections were chosen to maximize system control and signal quality.

The satellite will be used for bridging the 12 sites to economize on the space segment. Thus, only two two-way channels will be used on the satellite, rather than the 24 which would be required if a central bridge were specified. The major drawback of this system is that it can only be operated in a simplex mode.

The simplex mode will not affect system use, since classes offered to multiple groups of students require strict discipline with controlled student interaction, and since push-to-talk microphones are required in any case to minimize ambient noise. The graphics channels will have no difficulties operating in the simplex mode. For administrative conferencing, it will be possible to use both satellite channels to create one full duplex channel. Diagrams showing the system schematics are shown in Figure 2.

3.4 IMPLEMENTATION AND TRAINING

Project initiation is slated for February 1984. In anticipation, training in system maintenance has been provided for technical personnel, and other university personnel have received training in curriculum development and system planning and operation. Training activities include seminars in the U.S. and a large number of training seminars in Indonesia.

3.5 APPLICATIONS OF THE BKS PROJECT

When the BKS project begins operations the initial system applications will be as follow:

- Faculty Upgrading: The first major application will be the upgrading of university faculty teaching skills under the AKTE-V program. This program combines correspondence education with face-to-face tutoring to improve faculty pedagogical skills. The teleconferencing system will be used initially as a means of training some 150 tutors within the BKS, and possibly for some direct teaching of instructors.

- Distance Teaching: The first four courses taught on the system will be in the areas of forestry, soil sciences, ecology, and food sciences. These courses will use faculty located at one location teaching students throughout the BKS via the satellite system--approximately 450 students per course. At the individual campuses the teaching will be supported with videotapes, printed literature, and tutors.

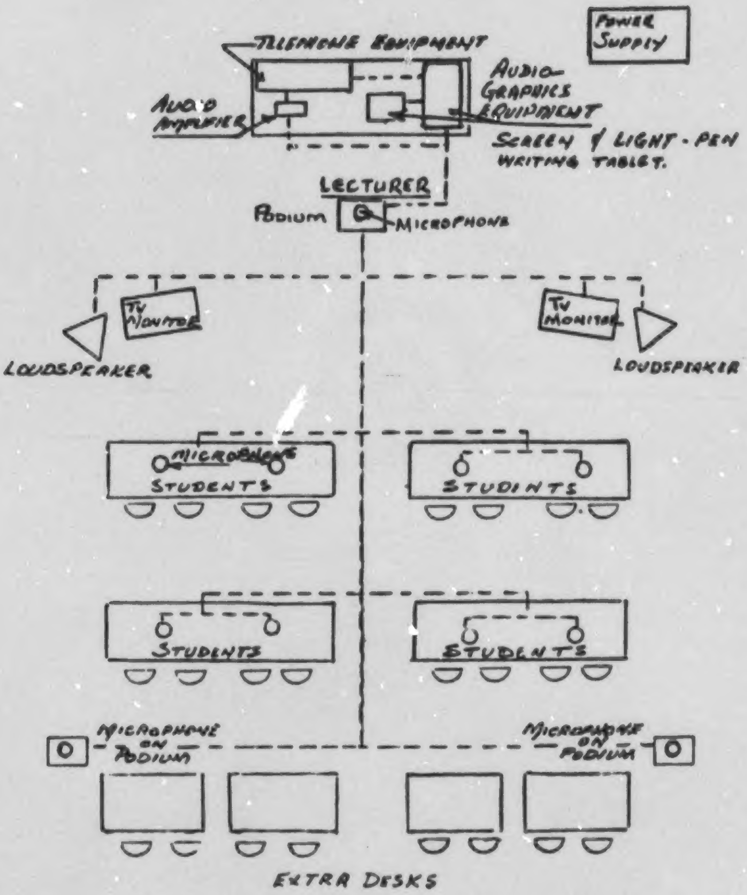
- Administration: The system will be used extensively for administration of the BKS and of the individual campuses. The BKS will use the system to further the integration of teaching and research functions by establishing teleconferencing among the university rectors, deans, and faculty. Finally, the system will be used for administrative support between separated campuses such as those at Cenderawasih University, whose two campuses are located on opposite ends of Irian Jaya (New Guinea).

Other applications relating to research, exchange of library materials, and remote campus teaching will be developed later in 1984, once initial applications of the system are firmly established.

The project will also include a study of how new technologies may be integrated into PERUMTEL's system to promote extension of communications to remote areas for development purposes. This study is slated to occur during 1984. Evaluation activities have been planned and are about to commence.

3.6 CONCLUSIONS

The BKS satellite project will be Indonesia's first serious undertaking in the use of its extensive satellite system for meeting the nation's educational needs. The marriage of telecommunications institutions and educational institutions has not come easily--nor has it in most other nations--but in the planning of the project, institutional barriers have gradually eroded and cooperative mechanisms have been established. With the start of project


POWER SUPPLY
TELEPHONE EQUIPMENT
AUDIO AMPLIFIER
AUDIO-GRAPHICS EQUIPMENT
SCREEN & LIGHT-PEN WRITING TABLET.
LECTURER
PODIUM
MICROPHONE
TV MONITOR
TV MONITOR
LOUDSPEAKER
LOUDSPEAKER
MICROPHONE
STUDENTS
STUDENTS
STUDENTS
STUDENTS
MICROPHONE ON PODIUM
MICROPHONE ON PODIUM
EXTRA DESKS

TYPICAL CLASSROOM

INDONESIA PROJECT

FIGURE 2

operations, a threshold will be crossed that could hold a breakthrough for Indonesia's economic development--a way to multiply the outreach of its trained expertise to rapidly expand its most needed resource: trained manpower.

4. PERU RURAL COMMUNICATION SERVICES PROJECT: IMPLEMENTATION STRATEGY

4.1 INTRODUCTION

The Peru Rural Communication Services Project began operation during November 1983. By integrating satellite telecommunications into the process of rural development, the project plans to multiply the effectiveness of existing expert resources, improve rural administration, establish reliable linkages between businesses and farmers and their markets and suppliers, and provide communication services to individuals as a way of upgrading the quality of rural life. Peru's national telecommunications agency, ENTEL, is implementing the project with funding from AID, which includes technical assistance by the Academy for Educational Development, project evaluation by Florida State University, and earth stations from the Harris Corporation.

The project is located in the Department of San Martin, on the eastern side of the Andes, where 6.2-meter earth stations have been installed in the towns of Juanjui, Tocache, and Saposoa. (See Figure 3.) The four communities of Bellavista, Huicungo, Pachiza, and Tingo de Saposoa are being linked to the earth stations via VHF radio telephones. Each of these communities will offer public telephone service. In addition they, as well as Tarapoto (the Department's principal city) and Lima, will have audio conferencing rooms for conferences among the project sites.

4.2 PROJECT IMPLEMENTATION

Within ENTEL, three working groups have been developed, dealing with the technology, its use, and an evaluation of the program's effectiveness.

4.2.1 TECHNICAL SYSTEM DESIGN, INSTALLATION, AND OPERATION

The technical unit, composed of ENTEL engineering staff, designed the overall technical system and installed the three earth stations supplied by the Harris Corporation. In late summer and early fall 1983 the earth stations were tested with the INTELSAT system and with public call offices and small exchanges established at each of the earth station sites. VHF links and the audio conferencing equipment are now being installed.

ENTEL's interest in undertaking the system design and installation assured that a broad range of technical knowledge was transferred from Harris and the other suppliers to ENTEL's engineers. All parties agreed that, in terms of long-term operations, this method was superior to a turnkey earth station supply that would have provided a more limited technology transfer.

4.2.2 APPLICATIONS PLANNING

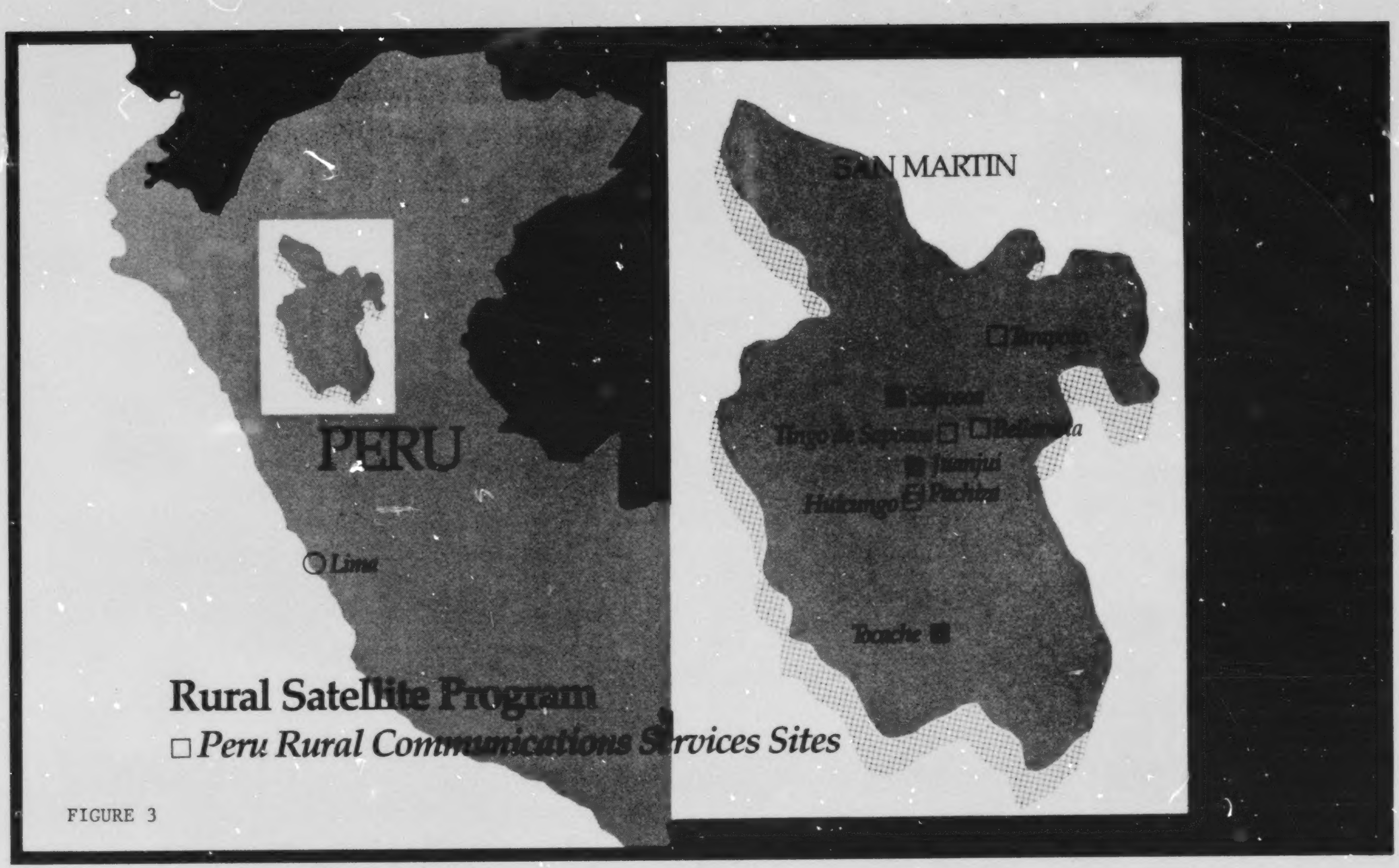
The applications unit is charged with promoting, implementing, and evaluating appropriate communication services which support the activities of the user groups. Facilities to support the applications program include a public telephone facility in each participating community, as well as audio conferencing rooms for the public service users and others with need for audio teleconferencing.

The primary public service users will be the Ministries of Health, Education, and Agriculture. A working group for applications planning and support, set up by ENTEL in Lima, includes agencies such as the Institute for TeleEducation and the Institute for Agricultural Research and Extension.

The audio conferencing system will generally be used for in-service training, administration, and project feedback and evaluation on a continuing basis. These functions have been notoriously difficult to conduct in rural areas on an effective or efficient basis. Traditionally, field employees in San Martin have spent enormous amounts of time traveling, trying to accomplish tasks that could be readily taken care of through a telephone call or a teleconference. In addition, it appears that important tasks such as ongoing project evaluation either have not occurred or have been given minimal emphasis, largely because of the difficulties in carrying them out.

Among the most immediate agricultural uses of the system are support to agricultural extension agents in the introduction of new varieties of corn, support of rice production management, and general in-service training, which will take place in weekly training seminars. In education, the support of community workers involved in a major pre-school education program is a prime application area. For local health workers the system will provide central administrative back-up support, in-service training, and diagnostic support in the areas of infant diarrhea, nutrition, and parasitology, among others.

In addition, non-governmental user groups are formulating their project utilization plans; they include agriculture-related business, such as suppliers, banks, and other financial institutions. The system will likely be used to improve the availability of seeds, fertilizers, and other agricultural inputs at local stores and outlets, thus improving and facilitating access of farmers to necessary supplies,


PERU
Lima
SAN MARTIN
Tarapoto
Saposoa
Tingo de Saposoa
Bellavista
Juanjui
Pachiza
Huicungo
Tocache

Rural Satellite Program

☐ *Peru Rural Communications Services Sites*

FIGURE 3

reducing their need to travel to larger towns for those purchases, and improving marketing practices. Most of the commercial applications will use the public telephone system. However, the ENTEL project staff will be working with the commercial sector to develop commercial uses of the audio conferencing system.

The process employed by ENTEL to develop these applications included the identification and organization of participating agencies, a thorough needs assessment, orientation and training of potential participants, and detailed planning for program services and teleconferences. ENTEL's capacity to provide this interface with public service users is one of the important institutional developments of this project.

In order to promote innovative system use, ENTEL is offering each of the participating agencies a specified number of toll calls daily, free of charge. In addition, use of the audio conferencing system by public agencies will initially be free of charge. Commercial users will pay the standard ENTEL toll charges.

4.2.3 SOCIO-ECONOMIC EVALUATION

The socio-economic evaluation of the project will provide information for policy development and for future programs by both ENTEL and the user agencies. It will assess the project's impact on the effectiveness of public service outreach activities, on the productivity of the agriculture sector and private commercial sector, and on trade and transportation. It will review the project's impact at the regional, community, and institutional levels. The evaluation includes a baseline analysis to establish the project's context, as well as an analysis of the project's use, costs, and administration.

The baseline analysis will include data on socio-economic conditions and key problems in the region, as well as existing communication linkages and practices at the community and regional levels. This analysis will establish the overall context within which the project operates and which it will hopefully help change.

Data gathering techniques have included interviews and systematic collection of secondary socio-economic indicators. Logs, questionnaires, and observation will be employed for the evaluation of system use.

Random sample user interviews with open-ended questions will be conducted to assess the system's socio-economic, cultural, and organizational impact. The cost assessment will gather the costs for hardware, installation, and operation of the system, as well as for the planning and use of the infrastructure by the user sectors. The cost analysis will look at the implication of the expansion of these types of rural communication services to regional or national levels. The administrative analysis will provide the project rationale and history, and discuss its institutional context and implications for the future.

This evaluation will offer one of the most comprehensive evaluations ever performed of the effects of introducing telecommunications into rural development activities. Its results are likely to have a broad effect on policy decisions in telecommunications investment in Peru, other developing nations, and foreign assistance and lending agencies.

4.3 CONCLUSIONS

The Peru Rural Communication Services Project is the only one described here, and currently the only one in the developing world, that is testing telecommunications as a multipurpose rural development tool. Thus, the assumptions being made around the world that reliable satellite telecommunications can be a catalyst for rural development--to reduce the administrative difficulties of providing rural services, to provide economic information links for farmers and entrepreneurs, to attract new investment, to develop regional cohesion--are being put to an important test in this project. The management of this "social experiment" by Peru's telecommunications authority itself helps to ensure that the project will address the questions essential to future decision-making and investment choices, and importantly, helps to ensure that the project's development orientation will continue on an operational basis after the initial project period.

5. THE UNIVERSITY OF THE WEST INDIES DISTANCE TEACHING EXPERIMENT

5.1 PROJECT BACKGROUND

The University of the West Indies (UWI) is continuing its experiments in the use of telecommunications to extend its services in the Caribbean region. These investigations began in 1978 with Project Satellite, during which the Jamaica and Barbados campuses of the university were linked by television for two months using NASA's ATS-3 and ATS-6 satellites, with USAID cooperation. The University Center in St. Lucia joined in for the final two weeks of the project. The experiments included a conference with the University of the South Pacific, using the ATS-1 and ATS-3 satellites. Project Satellite televised demonstrations, teleconferences, lectures, and outreach programs in medicine, agriculture, engineering, energy, and education.

A major outcome of Project Satellite was a recommendation that a study be conducted to examine the feasibility of a permanent UWI communications network to be used for administration, distance teaching, and outreach programs. This recommendation led to a grant of US$330,000 from AID for the Caribbean Regional Communications Study (CARCOST), completed in March 1982. The CARCOST report recommended a five-year pilot project with emphasis on teaching for the Challenge Examinations, in-service teacher training, medical and agricultural applications, the supervision of postgraduate students, and university administration.

5.2 UWIDITE PROJECT DESCRIPTION

The five-year project recommended by the CARCOST study is now under way, with funding from a variety of sources. The primary funding is being provided by the U.S. Agency for International Development, as part of the AID Rural Satellite Program. AID is providing US$600,000 over a three-year period, beginning in May 1982, to provide salaries and other project support, and US$220,000 for the communications equipment costs over a two-year period and for technical assistance and training. Technical advice is being provided by the Academy for Educational Development. The Commonwealth Association of Science, Technology and Mathematics Educators has provided £99,000 over three years specifically to support a program of training for secondary school technicians and science teachers. Additional funding is from the university and other sources.

The objectives of this pilot project, which has been named the University of the West Indies Distance Teaching Experiment (UWIDITE), are:

- to demonstrate that a sufficient level of actual demand exists to support an operational system;
- to create within UWI an interest in meeting identified demands using teleconferencing techniques, so that the institution will incorporate teleconferencing into its ongoing planning and operations;
- to establish a core of experience and of experienced workers to allow the efficient design, staffing, and implementation of an operational system for distance teaching and outreach;
- to help to develop mechanisms and expertise for the production of educational materials, e.g., print, audio, and audiovisual materials.

The system went into operation in March 1983. Initial programs have been developed in extension studies, or courses for credit toward a university degree; extramural studies, or special non-degree courses; and extension services to support agricultural development and information distribution. Extension studies programs are focusing initially on support for the Challenge Examinations System, under which students not resident at one of the main campuses may take their first year examinations in their home territories, and on certificate of education programs for teachers of reading and teachers of the deaf. Extramural studies will focus on programs directly related to economic development and social welfare, such as providing training for school laboratory technicians and in-service training for nurses and other health professionals.

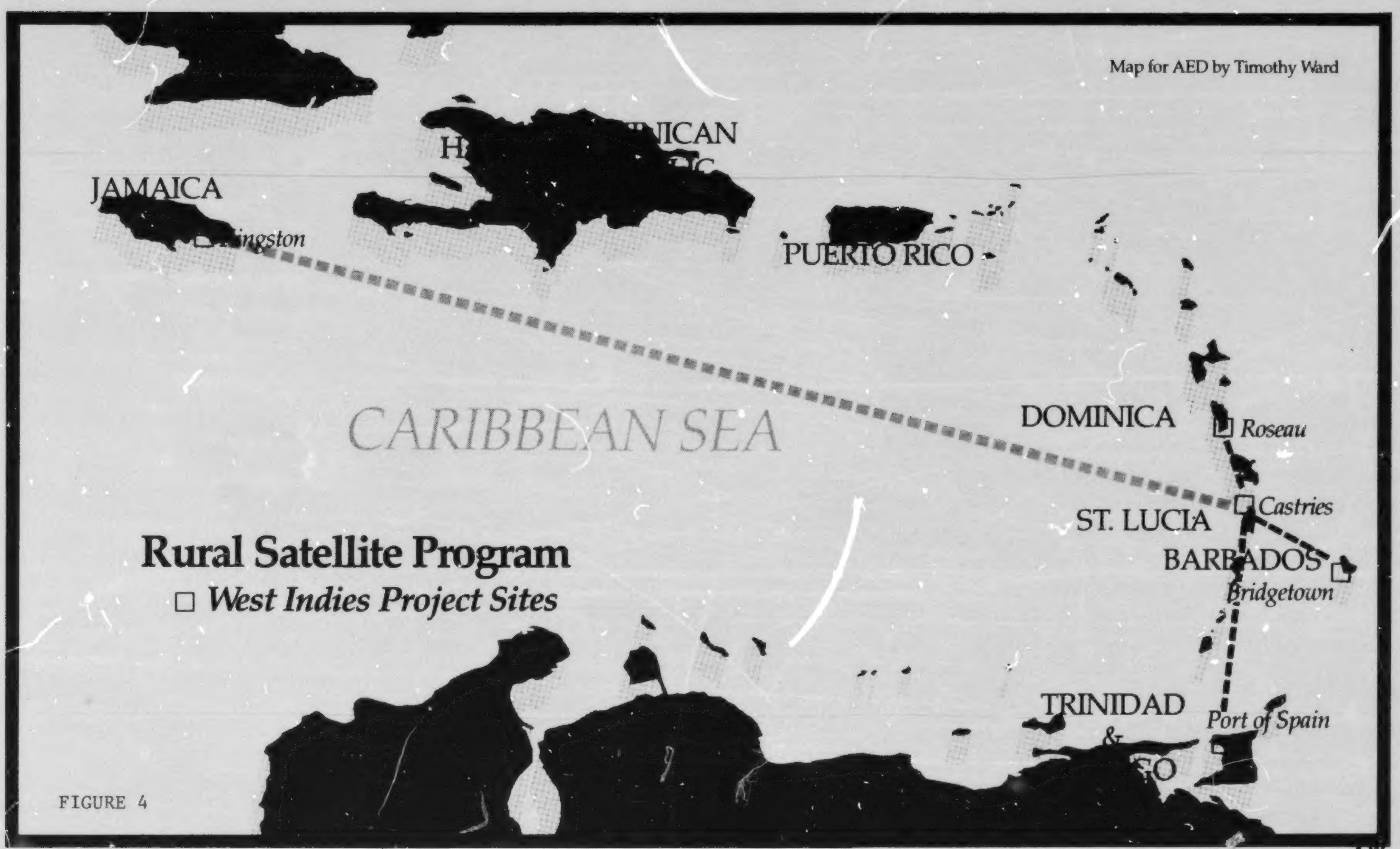
A typical weekly schedule might include in-service classes for teachers, UWIDITE coordinators' meetings, class sessions in each of the Challenge Examination courses, continuing medical education classes, administrative teleconferences, and medical case consultations.

5.3 THE TECHNICAL SYSTEM

The original discussions between the University and AID centered on satellite operations with small, inexpensive ground stations. However, several difficulties arose: the limited funding that was available; the uncertain lifespan of the only readily available satellite, NASA's ATS-3; and the restrictions on using U.S. domestic satellites for international programs. The UWIDITE system was therefore designed to use commercial telephone services already available in the Caribbean. There are presently five dedicated teleconferencing rooms in the system: one on each of the main campuses (Jamaica, Barbados, and Trinidad), and one each in the extension centers in St. Lucia and Dominica. (See Figure 4.) Each of these centers is connected to the appropriate international gateway via leased four-wire telephone lines. Jamaica is linked to the Eastern Caribbean via INTELSAT satellite, and the Eastern Caribbean countries are linked by tropospheric scatter and microwave radio. (See Figure 5.)

The AID grant has provided Darome audio teleconferencing equipment; each of the five sites has six microphones and two speakers, a convener, a telephone handset, and termination equipment that provides switching capabilities for additional peripherals and allows private line capability for two or more sites.

Slow-scan television has also been acquired for each site with assistance from Colorado Video. This will allow the transmission of visual information, such as medical x-ray films. Television cameras, video recorders, monitors, and editors have been purchased for the production of videocassettes, although playback equipment is still needed for several sites. The European Economic Community has agreed to fund the purchase of telewriters for all five sites, and microcomputers will soon be purchased by the university for the three main campuses.


JAMAICA
ingston
H
NICAN
PUERTO RICO
CARIBBEAN SEA
DOMINICA
Roseau
ST. LUCIA
Castries
BARBADOS
Bridgetown
TRINIDAD
&
GO
Port of Spain
Rural Satellite Program
☐ West Indies Project Sites

Map for AED by Timothy Ward

FIGURE 4

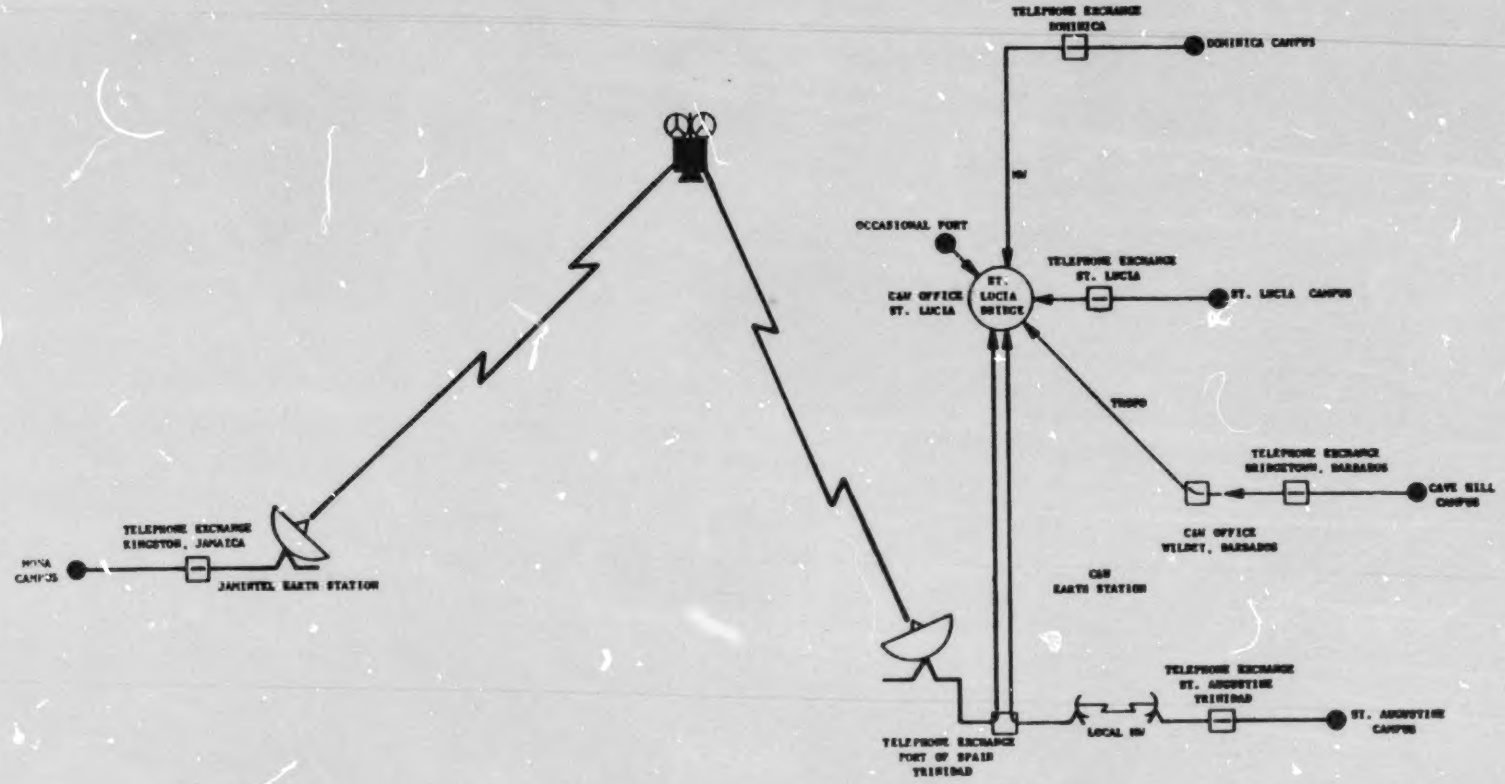

TELEPHONE EXCHANGE
DOMINICA
DOMINICA CAMPUS
MW
OCCASIONAL PORT
C&W OFFICE
ST. LUCIA
ST.
LUCIA
BRIDGE
TELEPHONE EXCHANGE
ST. LUCIA
ST. LUCIA CAMPUS
TROPO
TELEPHONE EXCHANGE
BRIDGETOWN, BARBADOS
CAVE HILL
CAMPUS
C&W OFFICE
WILDEY, BARBADOS
C&W
EARTH STATION
TELEPHONE EXCHANGE
KINGSTON, JAMAICA
MONA
CAMPUS
JAMINTEL EARTH STATION
TELEPHONE EXCHANGE
ST. AUGUSTINE
TRINIDAD
ST. AUGUSTINE
CAMPUS
LOCAL MW
TELEPHONE EXCHANGE
PORT OF SPAIN
TRINIDAD

FIGURE 5
UNIVERSITY OF THE WEST INDIES
TELECONFERENCING NETWORK

BEST COPY AVAILABLE

5.4 MAINTENANCE, TRAINING, AND TECHNICAL ASSISTANCE

The various local and international carriers--Barbados Telephone Company, Jamaica Telephone Company, Trinidad Telephone Company, Cable and Wireless, Jamintel, and Textel--are responsible for the maintenance and performance of the communication systems. Audio equipment was installed during February and March of 1983. University electronics technologists are responsible on each campus territory for the installation, checking, and maintenance of peripheral equipment and the testing of system performance.

Training of users, technicians, and producers of print, audio, and audiovisual materials is an ongoing process, and much has already been conducted. University staff have visited distance teaching programs in the U.S. and other parts of the world to obtain information on distance teaching programs and teleconferencing networks. Local training and seminars have been conducted on procedures for using the teleconferencing facilities, distance teaching methods, curriculum design, preparation of audiovisual materials, and program evaluation.

Much of this training is being provided as technical assistance through the Academy for Educational Development (AED), the applications management contractor for the AID Rural Satellite Program, and by Teleconsult, Inc., the hardware subcontractor to AED. An AED field office was maintained on the Jamaica campus during the first year of project operation to assist with implementation and initial training activities. The summative evaluation of the project is being conducted by Abt Associates, under a separate contract with AID.

5.5 PRESENT USES OF THE UWIDITE NETWORK

The UWIDITE network became operational at the beginning of March 1983. One of the first major users was the Regional Preschool Child Development Center, which developed a program aimed at improving the skills of trainers in early childhood education, developed a training module as a prototype for other content areas, and tested a new approach to meeting training needs throughout the region. The first Challenge Examination tutorials have been conducted for students in St. Lucia and Dominica in accounting, sociology, and economics. One-year courses leading to certification for teachers of the deaf and teachers of reading have been adapted for distance teaching.

It is estimated that the actual interactive time using audio teleconferencing, supported by slow-scan television as required, will be about one-third of the contact hours of the full-time courses. Students will receive the remainder of the content in study guides, workbooks, and audio and video cassettes. Videotaped materials on sign language, audiological assessment, and teaching the hearing impaired are being prepared for the course for teachers of the deaf.

The Director of the Law School and the Faculty of Medicine have begun investigating the possibility of developing continuing education programs using the UWIDITE network, and the Faculty of Agriculture is studying the system for future agriculture extension activities. Regional organizations outside the university have also begun to consider uses of the network.

5.6 PROJECT ADMINISTRATION

Direction of the project is centered at the Mona campus in Jamaica, under Pro Vice Chancellor Gerald Lalor. Each of the campuses has a Campus Coordinator, and each of the extension centers has a Resident Tutor. The Project Office in Mona is responsible for coordination of all sites for scheduling, technical coordination, administrative arrangements such as registration of students and distribution of materials, training, materials production, public relations, and outreach. The Campus Coordinators are responsible for work at their campus site and for technical assistance for the extension centers, as well as liaison with local governments and telecommunications authorities when required.

The project's Advisory Committee has been appointed by the Vice Chancellor to serve as a conduit for information between the university and the project, to advise on the structure and content of the programs, and to contribute to the evaluation and planning of operational services. The Advisory Committee is chaired by the Pro Vice Chancellor and is comprised of the Campus Coordinators; the Deans of the faculties involved in UWIDITE; and representatives of the Administration of each campus, the Planning Unit, the Extra-Mural Department, and the Bursary.

5.7 CONCLUSIONS AND SUGGESTIONS

UWIDITE is a bold new venture to apply modern but mature technologies to the educational problems of small states. It holds promise in several major areas of importance to the university and the region. First, it provides a new training option when, for reasons of scale, other options appear uneconomical. Second, it can transform the quantity and quality of outreach, consultation, and services which the university and other regional bodies can provide. And third, it improves many aspects of university administration. UWIDITE is presently being funded almost entirely from external sources. At the present level of operation, UWIDITE will cost some US$300,000 per year, of which over US$110,000 is needed for the leased lines. Funds must therefore be sought to ensure the continuation of an operational system, and to expand the system to include more of the island nations of the Caribbean.

6. CONCLUDING REMARKS

6.1 WHAT HAVE WE LEARNED?

The Rural Satellite Program is still unfolding. Operations began only in mid-1983 in the Caribbean, in November in Peru, and are yet to start in Indonesia. As the process has unfolded, we have learned--or in some cases re-learned--a number of things about the introduction of communications into institutions.

- The telecommunications and economic development cultures in most countries have had little interaction with each other. Both are wary of incorporating the other's considerations into their traditional decision-making and economic calculus. Telecommunications ministries (the ones that are participating in the program are pioneering exceptions) fear the potential economic drain of specialized services, services to the poorest regions, and services to other government agencies, which in the end might not pay. A successful pilot project could spell disaster, for it would generate a political demand for expansion that would quickly erode the PTT's revenue base. Social development ministries, on the other hand, often worry that telecommunications costs will run out of control, and also that they may then find themselves dependent on a technology that is not within their control. The progress toward concord made in the countries described suggests, with three very different approaches, that these problems can be surmounted, given persistence.

- As often shown before, once a reliable communications channel is in place, new users will rapidly emerge. In the Caribbean project, for example, the university is getting new service requests continually for use of the capacity. What is significant is that these requests are coming from institutions that have never used telecommunications before, and are in vital areas like agricultural training, health services, and family planning services.

- Costs are, in fact, coming down. An initial program target of a $65,000, two-to-four-voice-channel earth station, operating with INTELSAT, appears to be attainable this year. Compared with the INTELSAT-B stations of $1 million-plus when the program started, the implications for rural use are enormous. And today, the $25,000 earth station, with appropriate satellite power levels, is being widely discussed.

- New rural service offerings are developing, both through regional and national satellites, and through INTELSAT. Its projected VISTA service has been designed especially for thin-route rural applications and, most importantly will make it easy for nations to begin such services on a small scale. As barriers to easy entry vanish, we may well expect an explosion of interest, especially from the less-developed nations. We have learned, we believe, that a step-wise, evolutionary approach to these new services is the only acceptable one for most nations and particularly their user institutions.

6.2 WHAT DO WE EXPECT TO LEARN?

Many of the educational questions about optimal use of such a system remain to be answered:

- How can interactive narrowband telecommunications best be used for teaching, in the university settings, and for training and administration in rural areas?

- What adaptations in teaching styles will develop?

- What will the peripheral equipment be used for, and with what frequency, i.e., the microcomputers, facsimile devices, slow-scan, and audiographics?

- How will students' and teachers' reactions to this kind of teaching evolve over time?

- How is learning affected?

Other developmental questions include:

- How will the introduction of basic telephone services affect the structure and operation of agricultural production, including supplies of inputs and marketing?

- Will the introduction of audio conferencing in remote areas have a measurable impact on the efficiency and productivity of rural commercial activities?

Similarly, there are fundamental institutional questions that experience will help illuminate:

- How will institutions take advantage of the opportunity to reach greater numbers and to serve more specialized groups?
- Will there be a shift in the use of transportation versus communications? (Transportation costs are very high in both island and remote rural situations.)
- Among regional institutions, will a pattern of specialization develop, now that the ability to share resources through communications is in place?
- Will the institutions really incorporate communications into their basic operations and, if so, how?
- Will rural institutions function more effectively?

Finally, there are crucial questions of technological reliability, of costs, particularly of sustained operations, and of overall utility for economic operation of development programs.

AID expects to hold a conference in late 1985 to focus on these experiences. Meanwhile, progress is being reported in Uplink, a twice-yearly periodical of the AID Rural Satellite Program.(3)

In sum, thus far the project has most illuminated the institutional barriers to taking advantage of this great potential; fortunately, it has also shown that those barriers can sometimes be overcome. Technologies and cost constraints are steadily being reduced. We will discover more about the problems of users, and their solutions, as the projects proceed.

6.3 ARE THE PROGRAM'S OVERALL OBJECTIVES BEING ACHIEVED?

The initial objectives of the Rural Satellite Program have begun to be achieved. The program is providing a greater number of models for development planners around the world. As these models have become better known, a far greater sense of realistic possibilities is emerging. Investment priorities may be changing; important recent work by the World Bank and the ITU has placed a new emphasis on the utility of investments in rural communications. INTELSAT has become remarkably responsive and creative in designing new rural services. Manufacturers are more actively interested in the small earth station market, although uncertainty about the size of that market still exists. And, in a few countries, development planners are learning how to integrate telecommunications planning into overall economic planning.

Thus, the key barriers seen in 1979 are eroding. Numerous forces have come into play in driving these changes; it appears, however, that the Rural Satellite Program has been a contributor to this movement. The basic strategy of devising planned experiments in applications to socio-economic development seems to be bearing fruit. As the participating nations develop and share their experience, AID will continue to provide a forum, and a clearinghouse on technical information, so that the world community can assess the importance of this new development tool.

FOOTNOTES

(1) Many other individuals contributed to the preparation of this paper. Particular credit should be given to Robert Schenkkan for the introduction, Willard Shaw for the Indonesian project description, Anna Casey-Stahmer for the Peru project description, and Sandra Lauffer for the West Indies project description.

(2) Had earlier negotiations for an experimental payload on one of the first space shuttle missions been successful--the experimental "SYNCOM IV" concept--AID was prepared to fund several high-powered transponders for experiments by developing countries. When negotiations between NASA and Hughes Aircraft collapsed, AID was compelled to examine the use of already operational systems. AID has since "made a virtue out of that necessity."

(3) Inquiries reqarding Uplink may be addressed to Sandra Lauffer, Director of Information, Applications Management, AID Rural Satellite Program, AED, 1414 22nd St., N.W., Washington, D.C. 20037 USA.

VIDEOTEXT AND TELETEXT APPLICATIONS
IN SMALL ALASKAN COMMUNITIES

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3724 Campbell Airstrip Road
Anchorage, Alaska 99504

1. Abstract

Delivery of education and health services via telecommunications has a relatively long history now in Alaska. Delivery of supplementary print material has always been a problem due to mail delays. Videotext and teletext offer possible solutions to this problem and may have other applications in education and health.

2. PRESENT SITUATION OF RURAL SERVICES

Prior to 1971, there had been several years of effort in providing limited health services via high frequency radio in Alaska. No real effort was made to provide any educational services during the first years of Alaska statehood however. As a result of the ATS-1 experiments in health and educational services a strong continuing development was begun by both the state and federal goverments to provide a wider range of services in both health and education than would be possible otherwise. (1)

Presently the Alaska Public Health Service is providing support of health aides in some 80 communities through telecommunications with plans to expand to some 120 locations when funds are available. The Learn/Alaska Educational Telecommunications Network provides educational support to over 200 places at every educational level from preschool through graduate school. In addition, the Legislative Teleconferencing Network has expanded its services to over 40 communities throughout Alaska. (2)

In addition to the above public networks there are several private offerings being considered for computer networking, teleconferencing and other applications. Most of these are more active in Alaska's three major urban areas of Anchorage, Fairbanks and Juneau, than in its 250 plus small communities. However, one of the state's largest wholesale distributors has over 80 of his customers on a private computer network now with many of the network members being from very small villages.

The above summary is intended to merely outline the scope of telecommunications impact upon rural Alaska in the past 12 years. Having accomplished much, expectations have been raised that much more can be done in expanding the scope and utility of telecommunications services.. Having proven that much could be done for the small remote places, more is now being asked for by the health specialists, educators and others who are the providers of services to the people of the villages of the far north.

3. CONTINUING PROBLEMS OF RURAL TELECOMMUNICATIONS BASED SERVICES

About 75 percent of Alaska's communities rely totally upon air service for mail delivery. Most of the airports are not equipped for instrument operations and therefore the mail delivery system is extremely weather dependent. Other factors contributing to delays of up to six weeks in mail delivery are small aircraft unable to handle sudden surges in mail volumne and erratic scheduling by some operators.

The inability of the mail service to provide timely delivery of print material has hampered efforts at delivering telecommunications services from the very beginning in Alaska. Schedules, textbooks, training materials and other vital information were often not on hand when programs began. This led to frustration and general dissatisfaction from many users that communicated itself to other users and often carried to the public an image of incompetence or poor service that was more truly the burden of the mail service than the telecommunications delivery.

Experience and greater lead times could mitigate the above situation but it was and is a continuing problem with its greatest effect being on the ability to train health and educational practioners in telecommunications utilizations.

4. PROPOSED SOLUTIONS FOR TIMELY CONVEYANCE OF PRINT MATERIAL

As the University of Alaska and the Alaska State Department of Education extended their computer networks, they found that electronic mail was by far the most popular offering of those networks. The University of Alaska Computer Network (UACN) serves students and faculty throughout Alaska at the senior campuses and community colleges, a total of 15 locations. The Department of Education electronic mail system links the department headquarters in Juneau with school district head office sites at most of the state's 52 school districts.

Thus far, electronic mail service has been utilized primarily for administrative and interpersonal communications. It has been at best an adjunct to teaching. There have been some efforts to utilize it in a form of computer assisted instruction where information was distributed by electronic mail as an adjunct to audio conferencing.

In September 1981, the author distributed a planning document, The Next Stage of Telecommunications Planning in Alaska for Educational Systems and Other Public Purposes,which examined the decisions that should be made in the period 1982-85 to influence Alaskan communications capabilities in the 1990's. Videotext and teletext were two of the areas of concern identified in that document. The document was submitted to the Alaska Council on Science and Technology as a followon to earlier work performed by the Council's Telecommunications Committee. (3)

In April 1982, the Council made available to the University of Alaska Instructional Telecommunications Consortium s grant to investigate the possible uses of videotext/teletext in delivering educational and other public services in Alaska. The report requested by the Council was to provide information on the current status of videotext/teletext applications in Alaska and to make recommendations for the next stage of development.

In May 1982, a quick survey was made of educational, health and library service organizations to determine whether they had investigated use of videotext or teletext. The Alaska State Library had begun some investigations and all were interested in finding out more on the costs and technical problems associated with these services.

As a result of this interest, a workshop was convened in Anchorage which brought together vendors of videotext/teletext services with potential Alaskan users. The purpose of the workshop was to gain enough information about systems being offered to plan the next step. Telidon, the Canadian system, and Antiope, the French system, sent representatives. No reponse was received from any North American representative of Prestel, the British system. No system from a U.S. manufacturer was offered.

The major findings of this workshop were that there was no apparent reason why videotext could not be distributed over the regular telephone/data channels used in Alaska and that teletext could be distributed through the video-blanking-interval (VBI) of the satellite based statewide television channels.

The teletext option was especially attractive since the State of Alaska already purchases tow full video channels from Alascom and thus, teletext could theoretically be distributed statewide with no extra costs except for preparation of material and provision of encoders and decoders. Because of this particular Alaskan situation, there is a significant advantage for teletext over videotext or electronic mail systems that must pay line costs that average 45¢ per minute on the statewide audio conferencing net.

Enough information was gained at the workshop to enable the staff of the Center for Instructional Communications of the University of Alaska to prepare a request-for-proposal for a demonstration in Alaska.

5. VIDEOTEXT/TELETEXT DEMONSTRATION

Two major purposes were established for the demonstration: (1) to determine thoroughly whether any technical problems existed in Alaska, especially for the small earth station satellite network serving the rural areas; and (2), to familiarize a cadre of teachers, librarians and health practioners with videotext and teletext applications. This second goal would lay the ground for future more specific efforts in distributing a wide range of services.

One of the major problems in telecommunications planning in recent years in Alaska, and elsewhere, is that no funding source for experimentation has come forward to replace the programs sponsored by NASA and the old HEW in the ATS series. The result has been a gap in advance experimentation in many areas since 1976 in Alaska. In effect, we have been living off past efforts and the development of new theory in delivering education and health services at least has been missing.

The original proposal drafted by the Center detailed ten sites across the state where videotext services would be demonstrated. These sites were chosen to incorporate the widest possible range of different conditions that could be tested within the monies available.

After receiving responses from both Antiope and Telidon suppliers, Telidon was chosen as the most appropriate because it was the lead contender in the industry at that time to set the North American technical standards for videotext. Telidon also had several major efforts underway with major corporations, banks and other organizations in North America. Another factor influencing the decision was that expertise and support for the Antiope system had to come primarily from France. This was regarded as an unnecessary expense and complication, since Antiope did not appear to bring advantages that would outweigh the above factors.

System House, a Canadian firm, was chosen as the consultant to provide assistance in implementing the videotext/teletext demonstration. Funding was provided from the Learn/Alaska budget. Learn/Alaska is jointly funded by the University of Alaska, the Alaska Department of Education and the Alaska Department of Administration. The consultant was finalized in July 1982.

In September 1982, in conjunction with the Alaska Science Conference in Fairbanks, Alaska, another workshop was held with attendance from videotext/teletext applications specialists who interacted with educators, nurses, doctors, librarians and telecommunications engineers and specialists. The aim of this workshop was to broaden the base of technical understanding so that those interested in participating in the demonstration could begin to plan some utilizations of the system.

At present, the original proposal has been expanded to 15 sites as decreases in equipment costs have made it possible to expand the project and remain within the original budget. Equipment has been received and is in the final stages of installation as of October 15, 1983.

The normal range of installation problems has been encountered with problems in achieving adequate cooling being one of the most difficult. The problems emphasize the importance of gaining some hands on experience with systems, like that in Alaska, that are designed for a unique situation.

6. INUIT CIRCUMPOLAR CONFERENCE DEMONSTRATION

Another element in videotext development was introduced in March 1983, when a contingent of Greenlanders, Danes and Canadians visited Alaska as participants in an Inuit Circumpolar Conference (ICC) Executive Committee meeting in Bethel, Alaska. While passing through Anchorage, discussions were held with this group about the plans to use Telidon videotext to convey information from the ICC General Assembly meeting to be held in Frobisher Bay, Canada, in July 1983, to sites in Greenland, Denmark, Canada and Alaska.

As a result, eventual agreement was reached for videotext to be provided at three sites in Alaska, Anchorage, Bethel and Barrow. Telidon Canada donated equipment for the experiment and money to provide 600 pages of videotext informafrom the ICC meeting. Line costs from Frobisher Bay were borne by the recepient as were local installation costs.

The demonstration was a success at Bethel and Barrow with some 30 hours spent accessing vidoetext information from each site. Unfortunately, the equipment at Anchorage did not work.

There was television and radio coverage of the ICC meeting also. Combined with videotext information, the two Alaska sites involved were able to achieve a high degree of remote participation in this meeting where an Arctic Policy for Inuit peoples was one of the chief agenda items.

The demonstration certainly indicated that a high degree of teleconferencing and information conveyance can be achieved between the most remote sites when special efforts are made to incorporate those places in larger distribution systems.

7. CONCLUSIONS

Since the Learn/Alaska distribution system is not yet operational it is not possible to report on any conclusions regarding videotext/teletext applications as yet. The major conclusion thus far is that it is important to gain a reasonable level of experience in installations and operations prior to applications demonstrations. Otherwise, there will be frustrations and dashed expectations among those educators and other practiorers who must make the demonstration and test the feasibility of the application. This lesson was learned during the ATS experiments and is still valid. Combining technical demonstrations and initial applications is risky and must be clearly identified as to the level of expectations from the demonstration.

Where videotext/teletext will fit as a teaching tool in conjunction with television, computer assisted instruction, audio conferencing and other telecommunications applications will require a good deal of assessment and field testing. The upcoming demonstration is but the first step in learning about future uses in Alaska.

Likewise, it will be necessary to provide funding for libraries, health systems, legislative information and other users to conduct investigations in videotext/teletext applications in the same manner that early investigations in audio conferencing, television and computer assisted instruction were made.

8. APPLICATION TO OTHER PACIFIC AREAS

Alaska and the remote islands of the Pacific share the same problems of high transportation costs from their supply and administrative centers to most remote communities. Poor and slow mail service is another common problem.

A physician on the island of Mangaia needed ten days to convey information from Rarotonga by mail in 1981. He shares this experience with health practioners working in the remote Alaska villages. (4)

The efforts of the University of the South Pacific and other educational institutions throughout the area to deliver distant education services through ATS-1 is hampered by slow delivery of print material in the same way that Learn/Alaska is hampered. The response of USP to the problem was similar to the initial response in Alaska in that hardcopy was delivered through microcomputers. One of the things that educators must learn is whether the access features of videotext systems are more useful than similar access by microcomputer based systems and which is most cost effective. In this and a host of other areas, close collaboration over the next few years between institutions and systems with similar problems would be indicated. (5)

REEERENCES

(1) For a general review of the ATS-1 experiment in Alaska see R. Walp, Telecommunications in Alaska, (Honolulu, Pacific Telecommunications Council, 1982) articles by R. Merritt, p. 5-11; W. Parker p. 20-21; and H. Hudson, p58-63.

(2) Ibid, articles by S. Plummer, p. 22-25; J Demmert and J. Wilke, p. 69-73; and H. Hudson, p. 58-63.

(3) Referenced document can be obtained from the author or the Alaska Council on Science and Technology, Pouch A, Juneau, Alaska 99801.

(4) Hudson, H., "Three Case Studies on the Benefits of Telecommunications in Socio-Economic Development, A Report to the International Telecommunication Union", ITU, May 1981, p. A-29.

(5) Ibid, p. B-18.

Session 3

Communication Needs of Minority Groups

INFORMATION AND COMMUNICATION IN THE CANADIAN NORTH

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1. ABSTRACT

This paper examines information availability, accessibility and cost for the Inuit of Northern Quebec. Summarizing a detailed examination of the use of communications media for the distribution of information, the paper concludes with recommendations concerning the possible application of new information handling and telecommunications technologies.

1. INTRODUCTION

Recent developments in computer and telecommunications technologies have stimulated the interest of the public and excited professionals in an unprecedented way. The plunging cost and escalating capacity of systems for generating, compiling, storing and transmitting information has brought enormous information handling and communications power to the doorstep of virtually every home and office in the developed world.

The opportunities this represents for rural, remote and Northern residents is similarily outstanding if not overwhelming. In Northern Quebec, for example, all communities now have available the two prerequisites for access to these advances - local generators provide a power supply and the recently installed Telesat satellite dishes provide the telecommunications capability.

In a real sense, however, it is almost an embarrassment of riches - barely out of a nomadic, pre-modern era - the North is in a position to plunge directly into the post-modern, post-industrial age.

One feature, in particular, is striking about Northern Quebec when presented with these dazzling possibilities. Rather than be overwhelmed and passively accepting of the technological cornucopia, the Inuit have chosen in so much as has been possible, to control the pace and manner of the introduction of new systems. In addition they have looked to bend these systems to their own social and cultural purposes.

However, in these days of vast hydro-electric projects and gas extraction in the Polar seas; of constitutional conferences and land claims; of environmental hazards and the opportunities presented by huge cash land settlements; the ability to communicate what one knows though important is not sufficient. One must as a people develop the capacity to acquire the information available in the larger world, to manage it, and to assimilate it in such a way that it becomes a resource for acting effectively in the various arenas of modern life. It is in this context that our research was conducted and that this report was written.

What we have tried to do is to develop a picture of the information economy of Northern Quebec. Using this picture as a template it then becomes possible to evaluate the usefulness of the bewildering variety of technological options which present themselves.

2. INFORMATION IN REMOTE COMMUNITIES

Communications has become a frequently studied process in remote environments especially for indigenous populations. Communications is widely understood as being a key element in the developmental process and communication is widely seen by indigenous populations as well as by others as a positive good, bringing to them as to others, diversion and social and cultural contact. (1)

What is less frequently the subject of study is that sub-set of communications which is concerned with the origination, transmission and management of information. While communications are easily defined as the movement of messages between sender and receiver, information has to do with the content of those messages. While all information may be communicated as messages not all messages are information.

The study which we are reporting on was conceived to determine and ultimately map the flow of information into, out of and between the thirteen communities of northern Quebec.

Certain contemporary notions related to a supposed information economy are of interest in this context. Many would suggest that the residents of this region would be ideal examples of a class of information poor living in a society of the information rich. The region has no daily or weekly newspaper, no public libraries nor bookstores, one or at most two radio channels and either no or a very limited number of television channels. In most communities the majority of the adult population is literate in neither French nor English. While some 80% of the adult population read Inuktituut syllabics there has until recently been virtually no general interest publishing in this language apart from religious materials.

3. NORTHERN QUEBEC

The region generally known as Northern Quebec or to the officials of the Province of Quebec as "Nouveau Quebec" is an historical, geographical, linguistic/ethnic, administrative and (increasingly) political unit. Northern Quebec comprises all of Quebec's northern coastal communities including the eastern side of Hudson's Bay and Ungava Bay. The pre-dominant population is Inuit with a small number of Indians (Cree), primarily in the southernmost communty of Kuujjuarapik (Great Whale River/ Poste de la Baleine) (2) and a largely transient white professional and administrative population. The overwhelming majority of the population are Inuktituut speaking Inuit. (3)

While certain of the communities, notably Kuujjuarapik and Kuujjuaq (Fort Chimo) were settled slightly earlier (as Second World War air bases) the overwhelming majority of the population and their communities (and their populations!) are not more than 25 years old. Prior to this time the Inuit lived as they had lived at least since the first days of contact with whites (fur traders and missionaries) some 200 years earlier - migrating in the fall and winter, hunting and trapping and living in igloos; and returning to crude tents in the spring and summer. Permament settlement consisted of Hudson's Bay trading posts, missionary outposts and little else.

It was the building of permanent housing primarily by the Federal Department of Indian Affairs beginning in the 1950s which ended this migratory life and which provided the base on which the current thirteen communities of northern Quebec (and more generally, throughout northern Canada) was founded.

Economically, northern Quebec is similar to other northern regions - little economic base beyond subsistence hunting and fishing. The limited amount of employment in local communities is provided by the provision of public services and to a much lesser degree tourism. Other cash income is provided by trapping, welfare and unemployment insurance. Two notable differences between Northern Quebec and other Northern regions are the earnings gained from the sale of carvings and crafts through the Federation Co-operative de Nouveau-Quebec (FNCQ) and the funds provided by the James Bay agreement, where the northern Quebec Inuit ceded certain rights over the land in the region to the Provincial government for hydro-electrical development in return for a lump sum settlement of $92 million. (4)

This fund is managed by Makivik Corporation, an Inuit controlled company concerned with the stewardship of the Inuit financial patrimony and with using it to develop an on-going base for Inuit economic development. Makivik controls several other corporations or agencies which are active both in the region and provincially, including one of the two regional airlines, and a construction company.

In addition to Makivik there are several other Inuit controlled institutions serving the region. The main ones are the Kativik School Board which manages the school system in northern Quebec and obtains its funding from the Ministere de l'Education du Quebec; the Kativik Regional Government which is concerned with regional planning and providing assistance to the municipal governments in the region; the Federation Co-Operative du Nouveau Quebec (F.C.N.Q.), which acts as a wholesaler and developer to the regional community co-ops and which is the sole selling agents for Inuit handicrafts; and Taqramiut Nipingat Inc. which is responsible for regional communications activity.

Apart from these organizations a number of federal and provincial agencies are represented.

Apart from the Hudson's Bay which has a store in most communities and the three air lines, Air Inuit (owned by Makivik), Austin Airways (privately-owned and flying out of Timmins, Ontario) and Nordair (a mid- sized airline), which flies into both Kuujjuaq and Kuujjuarapik, there is virtually no private sector presence in the region apart from the occasional coffee shop or outfitter.

4. INFORMATION MEDIA IN NORTHERN QUEBEC

Information media are systems used for the transmission of information messages. To a degree, the nature of the transmission medium will affect the nature of the message which it is able to carry - thus for example face-to-face information transmission will allow for much greater affective and interactive communication (such as non-verbal) than other media. Some media allow for virtually no interactive communication, e.g. television broadcasting, while others are structured in such a way as to restrict multi-channel information transmission, e.g. the telephone. Still other media have features specific to them which are required for certain purposes - letters allow for the signatures necessary for certain legal documents; fascimile along with letters provide a written record of the information transmitted. Thus the availability of media as well as the pattern of utilization has a considerable bearing on information transmission.

While it is not possible to make an overall comparison between media use in Northern Quebec and other parts of Canada or elsewhere, it is interesting to examine media use as plotted against two factors which may be of importance in selecting media for information transmission/reception.

In Figure 1, we can see media use plotted against response time of those transmitting the information, i.e. how long it takes for those providing the information to respond to feedback from those receiving the information. It is interesting and very revealing to observe that high utilization in general is associated with

FIGURE 1: MEDIA USE BY SPEED OF RESPONSE TIME

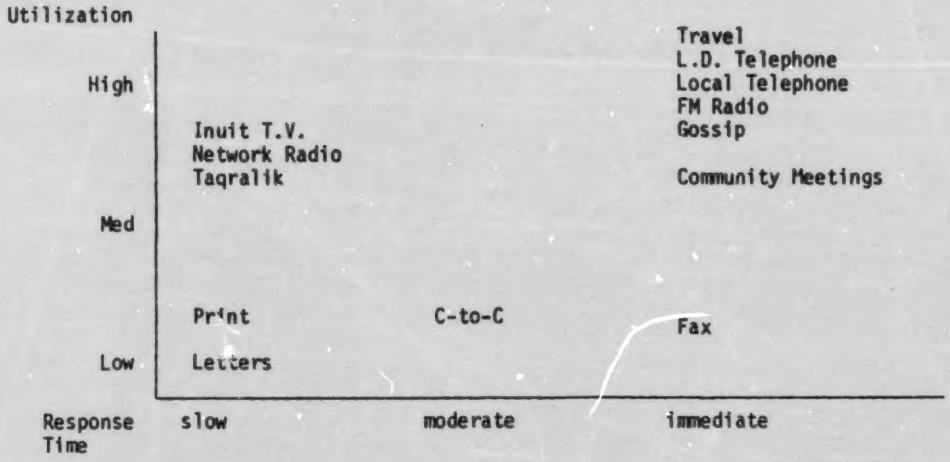
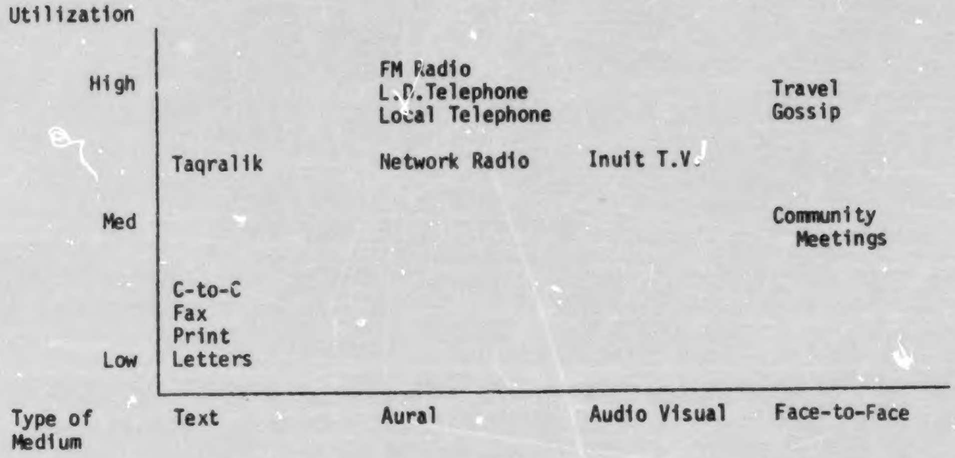


FIGURE 2: MEDIA USE BY TYPE OF MEDIUM



high responsiveness. The exception to this is for the broadcast media which have a high utilization but relatively slow responsiveness although for each of the broadcast media attempts have been made to increase the speed of responsiveness.

Figure 2 presents the distribution of media use by type of medium - whether face-to-face, text based or electronic. It is significant to observe that of all the text based media only Taqralik (with a very extensive photographs and graphics) is used to any great degree. Aural media are very important. Although this may be an historical accident or the result of relative costs it may also reflect the fact that the Inuit have traditionally been an aural culture where face-to-face relations have been primary and where other media have been unavailable until recently.

5. INFORMATION RECEPTION BY MEDIUM

Information is defined as an ordered message with cognitive content or meaning both to the sender and receiver. Within this definition then, messages which are sent by southern agencies and indivi- duals in English or French to monolingual Inuktituut speakers are not "information" to their intended receivers. Similarly the cultural messages which are received by Northern Quebec residents from U.S.A. initiated, satellite transmitted television broadcasting are not "information" in that no such "meaning" was intended for the transmission.

We earlier suggested that northern residents might be characterized by some as "information poor" but that such a designation was too blunt and ill-defined to describe the reality of the situation.

It is necessary to distinguish between information "availability" and information "reception" or "accessibility." Southern residents could be said, within the limits of reasonable cost, to have almost unlimited availability of information. Of course, they only to a limited degree access or receive available information. In the northern context the availability of information is much more limited and the making of information accessible, as for example through translating it into Inuktituut, is much more expensive.

If one were to develop information profiles for southern residents one could assume saturation levels of information availability for all information categories, although of course with differential rates of information access based on education, income, occupation and so on. Different profiles of information access could be developed for different occupational and income levels and demographic categories. In most cases, information access would be a function of individual interest and need rather than availability.

The following profile is based on two sources of information - interviews with individuals resident in Northern Quebec and a review of the content of various media for the delivery of information to and in Northern Quebec.

It will be readily noted that many of the more conventional media for the delivery of certain kinds of information in the South are either unavailable in the North (newspapers, magazines, network radio) or are inaccessible because of language or cost. Thus, for example, international and national news in the South are conventionally available from multiple radio or television outlets, daily newspapers, or on a more in-depth basis in weekly or monthly periodicals. In the North for the Inuit, such news is limited for Inuktituut speakers by the lack of language access for those media available as well as the overall lack of available media.

Similar limitations exist for other types of information as for example commercial and financial where existing media serving the region pay little attention to these areas and where in turn the local Inuit residents have relatively little interest in them.

Figure 3 indicates the position of different categories of persons in northern Quebec with respect to access to different types of information.

The monolingual Inuit overall is probably the worst off. He or she has relatively little access to international, national or even regional news, having to rely almost exclusively on the CBC radio news in Inuktituut (one hour/day). In the local and personal areas the FM radio, telephone service and extensive face-to-face visiting provide the range of information.

Commercial and financial information in the North is virtually unavailable. This does present a problem in that there is little access to commercial outlets potentially competitive with the local Hudson Bay and Co-op stores. Other types of information - health, educational and technical are relatively inaccessible both because of language limitations and because of media limitations. Local delivery systems - FM radio, television, gossip, telephone, HF radio provide considerable access both to Inuit cultural and to emergency information. Inuktituut-speaking ministers and publishing provide a relatively good access to religious information.

Bilingual Inuit (generally the younger and better educated) overall have better information accessibility in that they can access television in addition to radio news (for international and national events), and mail order catalogs for commercial information. In addition, they have access to a broader range of government, technical, health and educational information provided in English or French. (Very few Inuit - less than 5% - either speak or read French.) They do however suffer from considerably less access to information compared to Southern residents who

	Intn'l.	National	Regional	Local	Personal	Commercial	Financial	Gov't.	Health	Education	Organiz.	Religous	Inuit	Technical	Emergency
Monolingual Inuit	◔	◔	◔	●	●	○	○	◔	◔	◔	◔	◕	◑	◔	◑
Bilingual Inuit	◑	◑	◔	●	●	◔	○	◑	◑	◑	◔	◕	◑	◑	◑
Monolingual White	◑	◑	○	○	◔	◔	◔	◑	◑	◑	○	◔	○	◕	◑
Community Leaders	◑	◑	◑	●	●	◑	◑	◕	◑	◑	◕	◕	◕	◕	◕

FIGURE 3 Volume of information readily and cheaply accessible to Northerners

Key:

○ - No information accessible

◔ - Limited information accessible

◑ - Considerable information accessible

◕ - Most desired information accessible

● - Individuals have full information accessibility have a broader base of media from which information may be derived.

Monolingual whites are perhaps the most "deprived" of all in that they have experience of greater information access and thus know what information resources are inaccessible to them. (5) However, for many this retreat from information may be part of the attraction of Northern life.

Since most Northern whites are hired for their technical skills, they generally have sufficiently developed information support systems either personal or provided by their sponsoring organization. These ensure that required information is available either immediately by telephone, through print materials, or through travel "out" for training or travel "in" by trainers or experts. Relative to other Northern residents, however, they have little access to the regional or local information or Inuit culture which is presented for the most part only in Inuktituut. In addition, they have significantly limited access to personal information given the distance from family and friends.

The community leaders (Mayor, Councillors, Council members of Inuit organizations, etc.) have the most information available to them. Regular travel intra- and inter-regionally gives them access to international, national and regional information and commercial and financial information even though they may be monolingual. Significant efforts are made by responsible agencies to ensure that community leaders are provided with government, health and education information and extraordinary efforts and costs are undertaken to ensure that they all have organizational and Inuit-related information.

Figure 4 gives an indication of media use by types of information i.e. which media are used to deliver what types of information. What is notable is the variety of media used to achieve organizational information dissem- ination and equally, the variety of types of information delivered by and, even dependent on delivery by community meetings and travel.

6. AN INFORMATION DISTRIBUTION MODEL OF NORTHERN QUEBEC

It should be evident from the information presented above that the flow of information into and out of northern Quebec is a patterned response to a variety of contingencies. These contingencies include:

- the communications media infrastructure
- the cost of information transmission
- the information needs of northern communities

Let us look at the local northern Quebec community as a closed information universe. Given the geographical and linguistic isolation of most Inuit residents the assumption is not so very unrealistic. While local and personal information flows smoothly and quickly throughout the community - even through having appropriated and redeployed the modern technological resources of telephones and FM radios - relatively little information flows into or out of the community and what little that does is fragmented by type and by medium.

And yet these communities exist in the midst of a highly sophisticated political and technological society in which they are reasonably active participants. They lag only a few years in the utilization of certain consumer electronics and not at all in such areas as snowmobiles, airplanes and small engines. Politically and economically they are, through their leaders, involved in on-going discussions and negotiations concerning the great issues of the day - land claims, environmental and resource management, constitutional formulation, regulatory jurisdiction over telecommunications and so on. They have an interest in and an involvement with these and other areas through the Inuit controlled institutions of northern Quebec.

On the face of it the two realities cannot be reconciled. In practice the reconciliation takes place through the leaders found in a typical community. These individuals - primarily men - are the link between north and south and the key element in the information transmission system in the region.

Relatively large volumes of information are produced in the south for transmission and utilization in the northern communities. Some, but relatively little, is channelled directly to community members. Only limited amounts are available in Inuktituut; Inuktituut speakers may be at a disadvantage in that the language may lack the concepts or the words for describing the concepts required to assimilate certain of this information; transmission media in general are insufficiently developed for direct transmission to northern residents.

In place of this the northern oriented institutions have identified in each community one or more individuals to whom information is channelled. These individuals represent the community in the "management" of the institution while acting as the channel through which information is taken in and sent out, to and from the community. These individuals in turn use existing intra-community means - primarily the FM and face-to- face media for re-transmitting the information to other community members. An example of this is the local health committee. This is described by a local community Health Co-ordinator, Ungava Hospital: "Health Committees should be seen as a link between the population and the nurses and a channel through which information is passed."

Given the key role of the mayor, town councillors and town managers these most often are the key link for the community. The mayor is quite likely

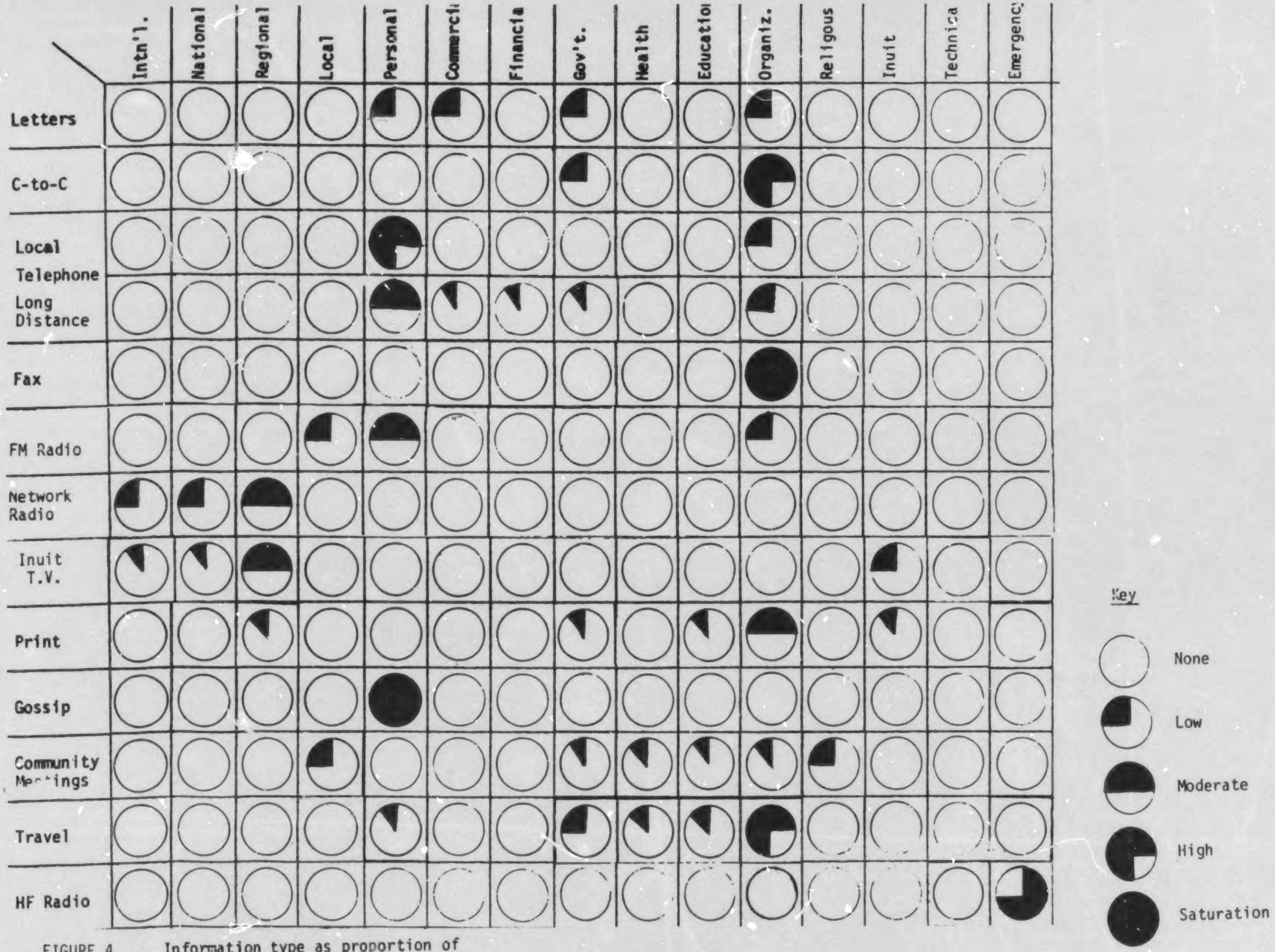


FIGURE 4 Information type as proportion of overall media utilization

to be bilingual and a good "politician"/communicator. He may have available as staff an understanding white - the town manager. Thus the mayor often becomes the key information handler in the community and between the community and the outside world.

The effective transmission of information into and out of the community may become dependent on the personal effectiveness of one or at most several individuals - with neither the training, experience nor additional resources to assign to the information/communication task. The effect of this, of course, is quite spotty and politically highly restrictive for community development. As well it places inordinate responsibility and pressure on the shoulders of the few community leaders involved.

It is not surprising that many communities experience a rapid turnover in the leadership group - both as communities become dissatisfied with what is in fact the information transmission capability of individuals (this is often described in other ways - becoming "high and mighty", "losing touch" etc.) - and as individuals collapse under the weight of the information overload to which they are subject.

This can be seen in graphic form in Figure 5. One should note that each organization channels its information through a different community representative but that all organizations channel their information through the mayor and council.

Information then flows directly from the south into northern communities and conversely from northern Quebec communities directly to southern institutions. This, of course, has significant advantages for both senders and receivers in that information is transmitted with relatively few relays and thus has less chance for distortion, degradation or loss. In this way, northern residents can exert more direct influence on "their" institutions than would otherwise be the case. It means also, however, that those few information relays or "buffers" are overloaded and play an inordinately important role in information transfer.

The three dominant media of information movement south to north are revealing. Two - travel and telephone are person-to-person media ie. where an intensity of two-way communication is balanced by a physical limitation on the secondary distribution of that information in northern communities. The third significant medium - print - is, in the northern Quebec environment, for the most part a one-way medium only, in that no print facilities apart from ordinary photocopiers exist in northern Quebec.

North-to-south transmission of information is visibly less than south to north. There are available significantly fewer effective media for such transmission. The two dominant media - travel and telephone - are both one-to-one information transmission systems and both are relatively high cost information carriers.

Effective regional media are notable by their absence (Figure 7). One-to-one media such as the telephone and travel are of course, used extensively but one-to-many media are not available at the regional level. This observation may be misleading in that most of the Inuit organizations see themselves as regional organizations rather than organizations involved in south to north information distribution or as southern organizations administering northern programs. At least one organization (Kativik School Board) intends to move north while others (Makivik and TNI) have set up regional offices for the North. However, the structure of information flow from these organizations is South-North (Figure 8) and to a much lesser degree North-South and the media utilized are for the facilitation of this, rather than for "intra-regional" communication.

The reasons given for the location of administrative facilities are persuasive. Their southern location, however, means that non-regional information flows through these organizations to the north and from the north through them to the south and then to the larger Canadian society.

This probably has inhibited the growth of strictly regional media - a regional newspaper, regional printing facilities, improved regional airline scheduling - since these organizations have been at least partially concerned with providing and upgrading media for south-north communication.

7. THE COST OF INFORMATION IN NORTHERN QUEBEC

In the discussion below we have made a whole series of assumptions concerning the transfer of information. First we will have identified an "information" unit which is comparable across media. In an experimental context this would be relatively simple in that one could develop a message unit with controlled information content and transmit it using the various media. The characteristics of the message unit could then be compared across media.

In the real world this is more difficult in that different types of messages are conventionally carried via different media and the information content of these will vary. After considering the alternatives we are forced to attempt to use different information elements for different media - rather like examining apples and oranges to get at the relative cost of fruit.

Thus, for example, a normal one or two page business letter may be compared to a two-page DEX to a five minute telephone conversation and to a five minute face to face discussion as providing a relatively similar information content. Again our intention is not to draw conclusions from the

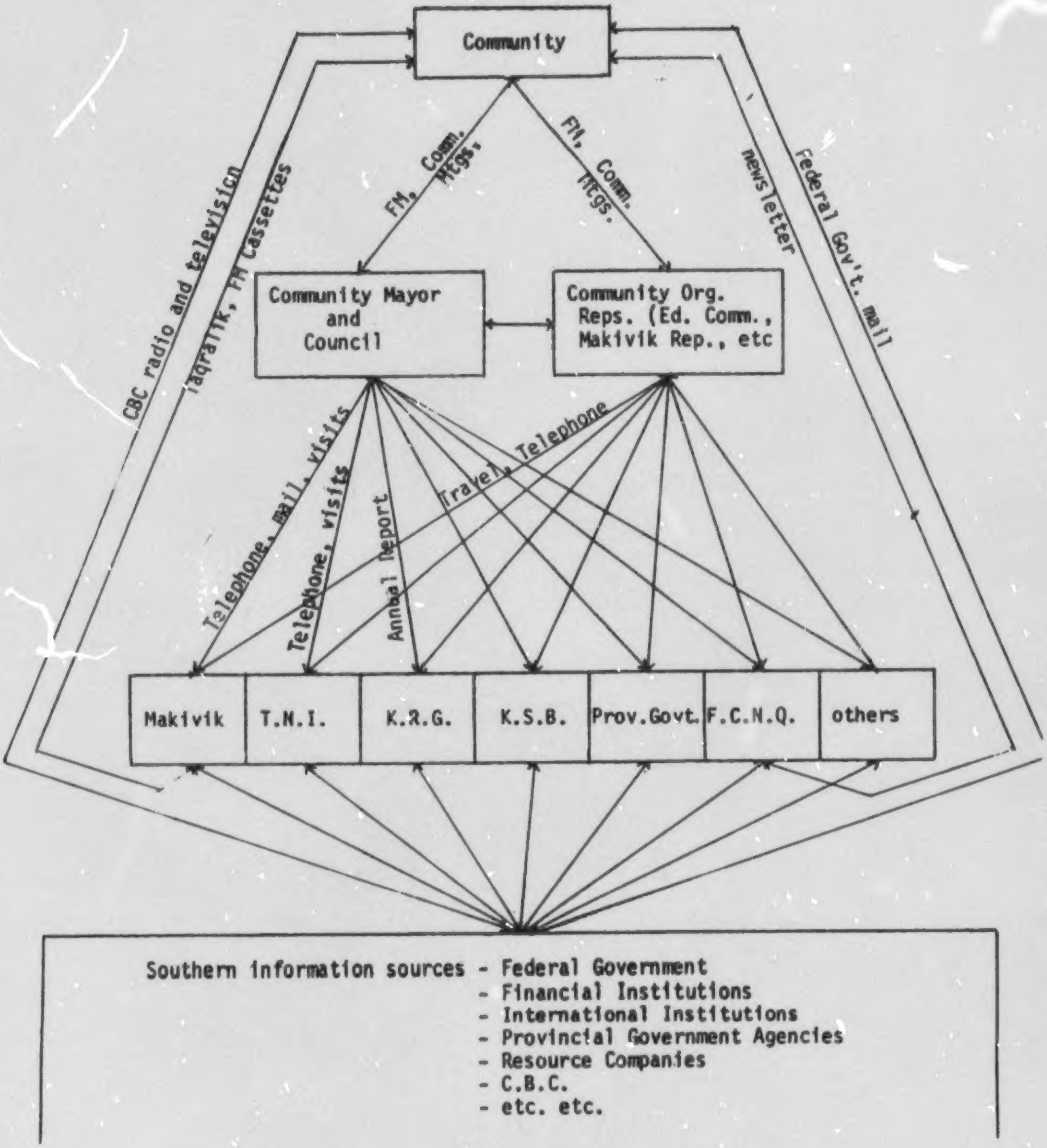

Community
FM, Comm. Mtgs.
FM, Comm. Mtgs.
CBC radio and television
Taqralik, FM Cassettes
newsletter
Federal Gov't. mail
Community Mayor and Council
Community Org. Reps. (Ed. Comm., Makivik Rep., etc
Telephone, mail, visits
Telephone, visits
Annual Report
Travel, Telephone
Makivik
T.N.I.
K.R.G.
K.S.B.
Prov.Govt.
F.C.N.Q.
others
Southern information sources - Federal Government
- Financial Institutions
- International Institutions
- Provincial Government Agencies
- Resource Companies
- C.B.C.
- etc. etc.

FIGURE 5: AN INFORMATION DISTRIBUTION MODEL OF NORTHERN QUEBEC

FIGURE 6: LOCAL INFORMATION DISTRIBUTION BY UTILIZATION AND TYPE OF MEDIA

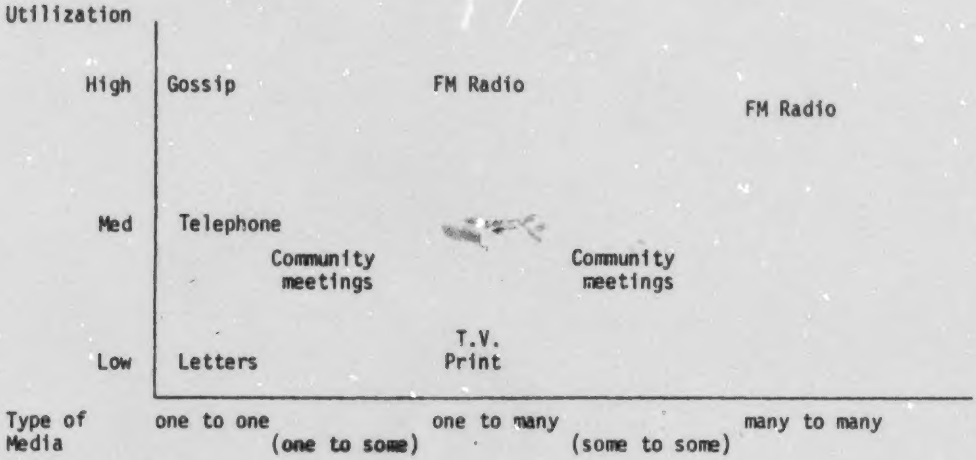
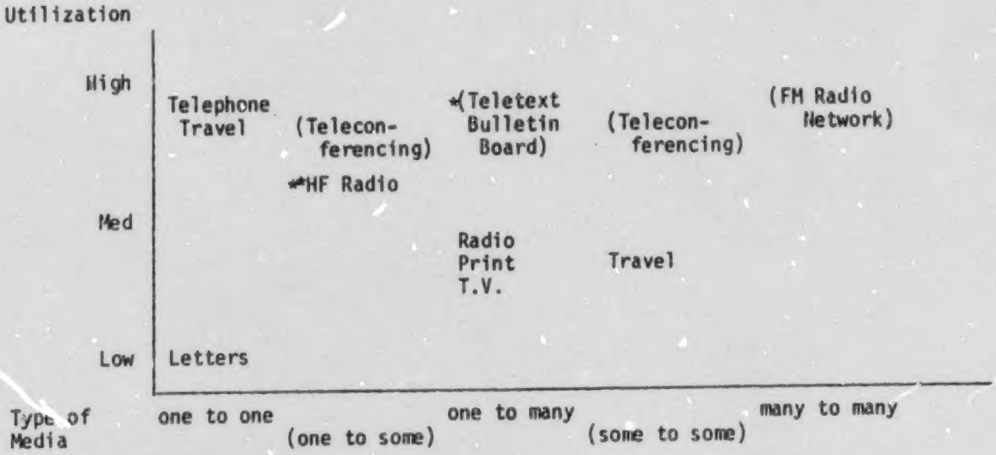
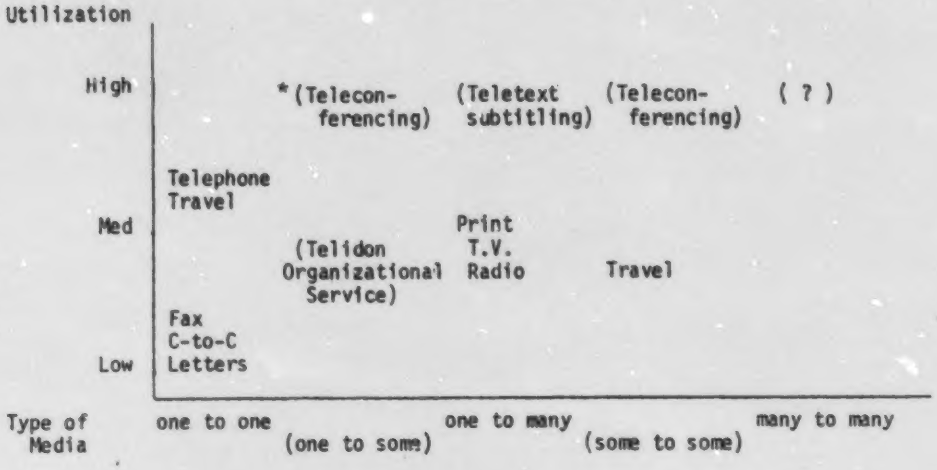


FIGURE 7: REGIONAL DISTRIBUTION BY UTILIZATION AND TYPE OF MEDIA



*(possible new service)
** now phased out

FIGURE 8: SOUTH-NORTH DISTRIBUTION OF INFORMATION BY UTILIZATION AND TYPE OF MEDIA


Utilization
High
*(Telecon-ferencing)
(Teletext subtitling)
(Telecon-ferencing)
(?)
Telephone
Travel
Med
Print
T.V.
Radio
(Telidon Organizational Service)
Travel
Fax
C-to-C
Letters
Low
Type of Media
one to one
(one to some)
one to many
(some to some)
many to many

* (possible new service)

detailed numerical results, but rather to make observations based on gross findings and relative positionings and patterns.

In addition, we will have to ignore the secondary benefits of certain forms of information transfer however important and significant in the media selection process they may be - the political and morale boosting aspects of travel and community meetings for example - to focus in on the cognitive informational components alone. Thus we will have to assume that five minutes spent in telephone conversation is equivalent in information transfer to five minutes spent in face-to-face conversation.

We have differentiated between production costs and distribution costs recognizing that for certain media the cost may be in the production (i.e. front end) while for others the costs may be in the transmission. Typically one-to-one communication has higher transmission and lower production costs presumably because the sender by knowing what to communicate to the receiver in order to have the desired cognitive effect can lower the production quality. Interactive communication typically has the least production costs in that the sender may rapidly adjust the message sent to correspond to the receiver's requirements, while one-to-many or broadcast communication typically has higher production costs (and values) since one is able to amortize the cost of distribution over a large number of receivers.

We will take as our baseline unit of measure the typical three page business letter for which costs have been calculated as approximately $6.00. We will in each of the media categories below indicate a rough equivalent information unit, e.g. 5 minutes of radio broadcast time, 3 pages of a magazine and so on. We recognize that this definition of equivalent information units across media is to a very considerable degree arbitrary. However, since the determination of media use for information transmission continuously involves just such an analysis, we feel justified in our attempt, however crude our instruments and thus our results may be.

As we have already noted, the different characteristics of the different information media determine the relative accessibility of information provided in one or another mode. One-to-one media such as letters or the telephone have very restricted accessibilty while one-to-many or broadcast media may make information accessible to thousands.

On the basis of our observations in Northern Quebec, we have in the following table (Table 9) estimated the numbers who are likely to have first order access to the information carried by means of the various media (i.e. directly access it rather than acess it through re-communication by an individual or via another medium. We would take rebroadcast of CBC radio signals by local FM stations as providing first order access.)

In Table 9, in addition to calculating relative production and distribution costs for information units via the various media, we have also calculated the comparative cost per individual to whom the information has been made accessible.

Figure 10 shows gross expenditures on information for various segments of Northern Quebec's population. Figure 11 gives total information related expenditures for the key organizations in Northern Quebec.

8. NORTHERN QUEBEC: AN INFORMATION NODE IN AN INFORMATION AGE

Introduction

It is frequently suggested that the new technologies will allow for (if not precipitate) a restructuring of organizations and States by allowing for increased decentralization, local decision making, local and small scale production and so on. The image which is presented is of a number of voluntarily conjoined sub-societies linked as a network by advanced information and communications technologies with considerable degrees of internal autonomy and engaging in consensual decision making on matters of mutual interest with others in the network.

This model has considerable attractions for a region such as Northern Quebec which is already isolated but which to a considerable degree values its isolation as a means for preserving its linguistic and cultural integrity.

Their participation in Quebec and Canadian society substantially conforms to this overall model with the contraint however, of continuing pressures toward centralized political and economic decision making coming from Central Canada.

Two highly significant areas of asymmetry however, disrupt the equilibrium which the Inuit are looking to maintain in their relations with the rest of Canada. The first of these is the area of one-to-many, i.e. broadcast communication. The failure to provide sufficient opportunities for Inuktituut language programming on CBC television (and more recently the acceptance of TVRO technology in many communities) is undermining the significance of both the Inuktituut language and the Inuit culture. Community controlled "on-off" switches for the TVRO systems may provide some measure of relief and the introduction of Inuktituut language Teletext sub-titling should also prove advantageous.

The development of the Inuit Broadcasting Corporation and North to North communications through the Circumpolar conference are also highly useful steps in re-righting the balance. By broadcasting in the Inuit language or even English language North-to-North broadcasting by Inuit

TABLE 9: UNIT INFORMATION COSTS IN NORTHERN QUEBEC

		Equivalent Units	Production Costs/Unit	Distribution Costs			Total Costs/Unit			Access-ability	Unit Cost/ Indiv. Accessability
				Local	Regional	S-N	Local	Regional	S-N		
Face-to-Face	Gossip	5 min.	0	0	-	-	0	0	-	1	0
	Community Mtgs.	8 min.	0	0	-	-	0	-	-	100	0
	Travel	5 min.	$1.25	-	$28.75	$28.75	-	$30.00	$30.00	20	$1.50
Text	Letters	3 page letter	$6.00	$.32	$.32	$.32	$6.32	$6.32	$6.32	1	$6.32
	C-to-C	3 page letter	$6.00	-	$1.75	$1.75	-	$7.75	$7.75	1	$7.75
	Print (Taqralik)	3 printed pages	$900.00	0	$.20	$.20	$9.00	$900.20	$900.20	5000	$.18
Electronic	Telephone	5 min. call	0	$.06	$3.00	$3.00	$.06	$3.00	$3.00	1	$3.00
	Fax	3 page letter	$6.00	-	$9.33	$9.33	-	$15.33	$15.33	1	$15.33
	FM Radio	10 broad-cast min.	$2.00	-	-	-	$2.00	$2.00	-	500/ community	$.004
	Network Radio	5 broad-cast min.	$32.05	Not Known	Not Known	Not Known				4000	$.008 *
	Inuit T.V.	3 broad-cast min.	$354.00	Not Known	Not Known	Not Known				4000	$.09 *

*Does not include distribution costs

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FIGURE 10

Communication Expenditure	Households	Community	Government	Makivik	K. R. G.	K.S.B.	FCNQ	T. N. I.	Total	Expenditure/ Person
Mail	----	----	6,000	8,500	----	15,000	1,000	----	33,500	$6.70
C-to-C	----	----	8,400	20,000	4,800	----	----	----	33,200	$6.70
L.D. Telephone	720,000	156,000	180,000	160,000	60,000	100,000	75,000	12,000	1,487,100	$300.00
Local Telephone	60,000	5,500	54,600	----	----	----	----	----	120,000	$24.02
Fax	----		----	6,000	----	6,000	----	12,000	13,200	$2.62
FM Radio	----	260,000	----	40,000 (tapes)	----	----	----	50,000	350,000	$70.00
**Network Radio	52,500 (capital expenditure)	----	300,000	----	----	----			300,000	$60.00
**Inuit T.V.	----	----	----	----	----	----	----	1,200,000	1,200,000	$240.00
Print	----	----	20,000	200,000	50,000	250,000	10,000	----	2,510,000	$502.00
Travel (Incl. accomodation)	----	----	172,700	810,000	560,000	850,000	150,000	150,000	2,692,700	$538.00
Total	832,500	421,500	741,700	1,244,500	674,800	3,224,000	236,000	1,413,200	8,619,700	
Expenditure / Person (05000 people in N. Quebec)	$175.00	$85,00	$150.00	$250.00	$135.00	$645.00	$50.00	$280.00	$1725.00	

* Includes all regional schools and Montreal Headquarters

** Does not include the cost of distribution

*** For the development of educational materials including film, text, audiotapes, etc.

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	Gross Info. Costs	Oper. Costs	%
Makivik	1.25 Mill.	3.8 Mill.	33%
K.R.G.	.65 Mill.	2.8 Mill.	23%
K.S.B.	3.22 Mill.	16 Mill.	20%
F.C.N.Q.	.24 Mill.	1.2 Mill.	20%
T.N.I	1.41 Mill.	2.5 Mill.	56%
Total	6.77 Mill.	26.3 Mill.	25.7%

FIGURE 11: INFORMATION COSTS

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broadcasters ensures that consideration is given to the cultural frame- work of the information being distributed i.e. that the information is framed in a manner reflective of Inuit concerns.

Additionally, as we have already noted, the Inuit are highly skilled and active in many-to-many communications even including the adaptation of broadcasting technologies (FM radio) to this form. However, no means currently exists to allow for many-to-many communications as between Northern Quebec and Southern Canada nor between Northern regions (although circumpolar conferences and sporting events are moves in this direction).

If Canada is in fact an "information society" then Northern Quebec is a significant information node within it. All Canadians are poorer if there is only a one-way flow of information going into the region and little information coming out for sharing with other "nodes" in the "network."

Regional Communications in Northern Quebec

The major gap in information transmission in Northern Quebec is intra-regional. Costs are high and few media are available for the transmission of information from community to community.

Several experiments associated with the Hermes and ANIK B satellites demonstrated that there were no technical barriers to many-to-many communications within the region - an FM radio network and radio and television "call-in" programs, for example. Subsequent evaluations determined that these were among the most popular features of the technology trials. Our own interviews revealed a continuing desire for better information distribution community-to-community in the North.

There are continuing discussions concerning the development of an "independent" newspaper for the region and considerable support has been given to this as a means for better distributing information. The development of an FM radio network in the North could satisfy the desire both for many-to-many regional communications and for simple broadcast information distribution. Again the availability of satellite communications could facilitate the development of such a system.

The second problem area related to regional information distribution is cost, especially the overall volume of financial resources which regional information distribution is consuming. As we noted above, over 20% of all expenditures in Northern Quebec may be related to information distribution and of this perhaps 80% is being consumed in travel.

It is evident from our analyses of media utilization that alter- natives to travel, in order to be successful, should have a very rapid response rate and be at least "aural" in the breadth of their communicating capability. This probably eliminates Telidon as a significant alternative as well as other forms of electronic mail service such as electronic conferencing or even Telex.

The availability of excellent telephone transmission service does however present the possibility of telephone based some-to-some (committee), one-to-some (training) and one-to-many (political) communication. It is noteworthy that the Makivik Executive Committee is already actively using telephone conferencing in place of certain executive committee member travel.

Studies on various forms of teleconferencing have found that for most purposes telephone conferencing is as effective as full video conferencing especially when the participants are already well known to each other. However, we have already noted the significance of face-to-face communication traditionally and currently in Inuit information dissemination.

The major limitation on full video teleconferencing is cost - the cost of the satellite uplink ($280,000/year + capital installation) and the cost of having access to the full satellite transponder (currently $6000/hour) required to carry the full video image. These factors have limited the utilization of video conferencing throughout the world to only the largest and wealthiest companies. Although it is reported that the cost of transmission may decline significantly (to $2000/hour), this decline may still be insufficient to make this mode of information transmission affordable in Northern Quebec.

Intermediary between full video and audio-only conferencing is slow-scan or freeze frame teleconferencing. This technology is similar to facsimile copying in that a picture of an image is digitized by a special camera. This digitized image is transmitted along the telephone network to a receiver where the image is reconstituted and displayed on a television screen. Conventional images are changed each 20-30 seconds so a continuing one way visual contact can be maintained. The cost of this system ranges upward from around $50,000 including camera, encoder and decoder. To this must be added the long distance charges for the telephone line and for a second telephone line to carry the voice link. The system is used fairly extensively for transmitting medical information and is currently finding a variety of educational applications.

In the context we are describing, as a continuing substitute for certain travel requirements, the image would only be specifically useful for certain applications - charts, photographs, maps, etc. - otherwise its use would be to enhance the attractiveness of the system as a means for conveying information.

One could envisage a service with suitable transmission facilities in Kuujjuaq and perhaps

Montreal and with receiving facilities in each community in the North.

Local Information in Northern Quebec

We have already extensively discussed the communication of information locally in Northern Quebec. We have also discussed problems relating to information management at the local level. As we have noted, the communities of Northern Quebec do not have a tradition of paper records and moving directly to electronic storage might be very appropriate.

This same observation is applicable in another sphere, as for example that of the preservation of traditional cultures. We noted that one of the problems most frequently cited in our interviews in the region was with the preservation of the Inuit language and culture. Southern European society has relied on print as being the primary medium for the preservation of traditional information. Lacking a print tradition, much is being lost in Northern Quebec in the absence of media for recording it.

The development of low cost video recording systems provides a means to overcome this problem. It should be recognized that for Northern Quebec, the video camera can be the equivalent of the historical archive, the local history, or the family diary. The maintenance of an electronic record can be as valuable and as valid as any other form.

Having accepted this argument, then agencies both government and private should ensure that such recording facilities are as available and accessible in communities as more conventional media are available in Southern communities. Programs promoting local history, development of educational materials, local record keeping should all be adapted to the video image as the primary source of record rather than the printed page.

The wide distribution of video recorders in the North and the availability of local T.V. transmitters suggests that this might be a means to promote and enhance traditional language and culture as well as to record and preserve it.

REFERENCES

1. For an extensive review of this area with a continuing interest in the Canadian North, see the work of Heather E. Hudson, ed., The Northern Pilot Project: An Evaluation , July 1974; "The Role of Telecommunications in Socio-Ecnomic Development," Issues in Communications, International Institute of Communications. V. 2, 1978, pp. 5-54; and "Modern Technologies can Serve Traditional Cultures," Intermedia, V. 11, no. 2, London, 1983, pp. 39-42.

2. Inuit place names will be used throughout this report. In many cases communities have three names (English, French and Inuktituut), with a variety of transliterations to non-syllabics of the Inuktituut names.

3. Paddy Gardiner in a study conducted in 1978 reports that in Inukjuaq, 96% of those interviewed spoke Inuktituut in the home and in Fort Chimo, some 73%. See P. Gardiner, Remote Arctic Quebec: A Study of Telephone Service in the Satellite Served Communities, March 1978, p. 64.

4. It should be noted that there is continuing opposition to this agreement based in several communities especially Povungnituk and expressed through the organization I.T.N. This group is opposed in principle in the formal ceding of Inuit lands.

5. From this category should be excluded a sub-category of Northern whites, many of whom are working for Inuit organizations who have married Inuit women and frequently have learned Inuktituut. They have considerable access to both Inuktituut and English (or French) language information and they, along with their wives, frequently serve a very significant role as cultural and linguistic intermediaries between white and Inuktituut societies.

BRIDGING CULTURAL GAPS IN THE PAN-ARCTIC

Thanks to International Videotex Services

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Abstract

A demonstration of Telidon technology at the third general assembly of the Inuit Circumpolar Conference shows that an international business information system designed to meet the needs of the «electronic office» could provide some useful interactive information services in the Pan-Arctic.

When the representatives of some 4 000 Inuits from Alaska, Canada and Greenland met July 25 to 31, 1983 at Frobisher Bay in Canada's Northwest Territories for the third general assembly of the Inuit Circumpolar Conference, news media coverage focused principally on some of the more dramatic issues of Arctic development. Such emphasis was to be expected. The stated purpose of the Inuit Circumpolar Conference - recently granted non-governmental organization status at the United Nations - is to defend the culture and rights of the Inuit people from the encroachments of the white man's civilization and particularly to protect the environment, on which they depend for their survival, from the effects of industrial development. A descriptive folder published by the ICC states:

> «Since the beginning of time the Inuit and the Arctic environment have been inseparable.
>
> Developments in industrialized majority societies naturally have an effect on the Arctic today. New forms of industry and work emerge, and the Inuits try to adjust as well as they can. But the living resources in our seas and on land are and will continue to be the dominant basis of our existence.
>
> The ICC defends the culture of the Inuit and the rights of the Inuit. But the ICC is also a guardian of the Arctic environment and its animal life. A guardian against pollution of the pure Arctic waters. A guardian of animal life - musk ox, reindeer, wolves, hares, polar bears, whales, seals, walrus and innumerable bird species. Help us to put up an effective defence.»

There are said to be some 100 000 Inuits living all over the Arctic from Siberia across Alaska and Arctic Canada to Greenland. About 3 000 are Soviet citizens, living in the extreme eastern part of Siberia - facing the Bering Strait. Some 24 000 are Americans, living on the western and northern coasts of Alaska. On the north coast the Inuit of North Slope Borough have developed some degree of local autonomy, and in 1971 all Inuits in Alaska concluded an agreement with the U.S. government under which they waived their original territorial rights in return for compensation and ownership of specified areas. About 24,000 are Canadians living in Arctic Canada and Labrador. Even though Inuit organizations in Canada have fought since the early 1970's for local autonomy, Canadian Inuit have no independent rights. Some 40 000 Inuits are Danish citizens living in Greenland; in 1979, they won the right of home rule, giving them legislative powers in respect of most local affairs.

In view of the weighty political and social issues discussed at the ICC's third general assembly, it is perhaps not surprising that the news media ignored an unusual international demonstration of telecommunications skills and Novatex technology which, if properly implemented, might assist the Inuit in maintaining their cultural integrity in addition to providing a wide range of useful services. Designed to show how Canadian technology can bridge communication and information gaps in the Pan-Arctic, the demonstration required the participation and cooperation of the Canadian Department of Communications, Greenland Telecommunications and the Danish Post and Telegraph, Bell Canada, the University of Alaska, the Inuit Broadcasting Corporation, the Inuit Tapirisat of Canada, the Inuit Circumpolar Conference and Teleglobe Canada. A word about ourselves:

Teleglobe Canada provides Canadians with a full range of international telecommunications services: telephone, telex, telegraph, radio and television transmission, computer communications and private leased circuits. Since 1950, Teleglobe has built up a vast, modern international telecommunications system through interconnections with global networks of submarine cables and communications satellite circuits. The Corporation interfaces with Canada's domestic telecommunications carriers and works closely with foreign telecommunicators and international telecommunications organizations. Teleglobe is part owner or holds long-term leases for the use of cables that span the Atlantic and Pacific Oceans, reach into the Mediterranean, the Caribbean and as far as Asia. Through Intelsat, the International Satellite Telecommunications

Organization, Teleglobe is part owner and a user of satellites that provide access to the more than 100 member countries of the organization. Through INMARSAT, the International Maritime Satellite Organization, Teleglobe provides service to the shipping and offshore oil industry.

In an environment of rapid technological change, Teleglobe endeavours to develop new services to meet the needs of the «electronic office». For example, new text transmission services for word processor communication as well as improved facsimile services have been launched. In addition, Teleglobe is complementing the overall Canadian effort in the marketing of Telidon technology in the international field by establishing an international business information service called Novatex.

Novatex is based on the new North American standard for videotex. It provides decision-makers with instant access to data banks of condensed high-value business information through one convenient source. Novatex offers users three major types of service:

1. Specialized business applications:
Information and transactional services custom designed for specialized sectors, are provided on-line by established information providers in each sector. These services are of high value and of immediate interest to executives who at present must rely on multiple sources to satisfy their information needs. The major value of these applications includes ease-of-use and instantaneous update from a single source, available to users on an optional subscription basis. One of the most important specialized applications now available is focused on the securities and commodities area.

2. General business applications:
The Novatex data bank includes a wide spectrum of data directed towards the general business user. It includes continuously updated business new services and price performance of top stocks, international commodity and monetary information and statistical trends and other data relating to international trade.

3. Corporate applications:
Space is available in the data bank for use by multinational organizations in private applications. Videotex has been used successfully by a number of organizations for internal services; Novatex provides the opportunity for international expansion of these applications, which may include company management information, marketing support or worldwide messaging.

When the third general assembly of the Inuit Circumpolar Conference was organized, Teleglobe Canada was asked by the Department of Communications to provide both the storage of the information data base, using the Novatex host computer located at its Toronto International Center, and its share of the telecommunications links from Toronto to Nuuk and Copenhagen (slides 1 to 4). While an international business service based on videotex and the information needs of Inuit delegates might not appear to have too much in common, in fact Novatex was selected because it can display Inuit characters, because text and graphics are received on the terminal screen in superior detail and in full colour, and because it is quite user-friendly. Teleglobe Canada also provided technical assistance to ensure that the 24 Telidon user terminals could access the data base, as well as helping the Department of Communications with respect to page creation and input.

This input, in English and Inuktitut, the Canadian Eskimo dialect, totalled more than 400 pages of information including such topics as general interest news, conference activities, background information about the Inuit Circumpolar Conference and about other Inuit organizations, educational material as well as a bibliography. The welcoming pages were in nine Eskimo dialects. Here are some sample pages (slides 5 to 12). A simple instruction sheet was developed to get around the initial difficulty experienced by users unfamiliar with videotex terminals. All these efforts resulted in up to 8 000 call-ups per day for these pages from the different terminals. Dr. Marianne Stenbaek of McGill University, Coordinator of the Communications Commission of the Inuit Circumpolar Conference and one of the principal instigators of the demonstration, pointed out to the author that among the potential benefits which the demonstration helped identify more clearly was the ease of access of such a system to educational material not normally available through other means. Among the users were many children who took to it like a fish to water.

«It became apparent during the demonstration», says Dr. Stenbaek, «that the system had educational potential which had not been previously identified; it forces children to read and learn, and they enjoy using the system». Another unexpected use which also became apparent during the conference was the provision of information about health care and services, particularly regarding action to be taken in an emergency. However, according to Dr. Stenbaek, the experiment fell somewhat short of its intended objective of demonstrating Telidon's potential as an interactive news system. The interactive capability of the technology was not put to full use as a result of unexpected equipment problems, operator inexperience and, perhaps most importantly, lack of time. «We had hoped to publish the conference resolutions on the system and obtain immediate feedback»; says

Dr. Stenbaek. «Unfortunately, we were just not able to fully implement this potential feature». Also not implemented was the possibility of input from and feedback to Anchorage and Greenland. Additionally, some participants felt that the information content was too obviously prepackaged in the South and not sufficiently adjusted to the needs of the Arctic Peoples.

But if this demonstration did not conclusively show how high technology can bridge communication and information gaps in the Pan-Arctic, it did, nevertheless, reveal some hitherto unexpected features and potential benefits which may have immediate applications. As one of the many events marking World Communications Year, it also fostered a remarkable degree of international good will and cooperation.

Notes

Plenary Roundtable Discussion

'Bridging Needs and Resources'

Notes

The Canadian MSAT Mobile Satellite Program

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Abstract

This paper describes the Canadian Mobile Satellite Program, MSAT, the primary objective of which is to develop mobile-satellite communications services in the 806-890 MHz band. The results of MSAT studies to date, Phase A (Concept Feasibility) and Phase B (Project Definition), are presented for a government-led demonstration satellite scheduled for launch in 1988. The alternative industry-led program leading directly to a commercial system and involving Canadian and US concerns with government participation is briefly described.

INTRODUCTION

The primary goal of the Canadian MSAT Program is the development of mobile satellite telecommunications services in the 806-890 MHz band. Although mobile communications satellite systems have been studied in Canada for over a decade, there was no allocated frequency band suitable for public mobile-satellite service prior to 1979. An earlier system under consideration, called MUSAT, had been intended to meet government mobile communications needs using the 225-400 MHz band. With the conditional shared allocation of the 806-890 MHz for mobile satellite services by the 1979 WARC, it became possible to meet a much broader range of public and private mobile communications requirements, and thus the concept of MSAT was born.
This paper describes the development of the MSAT Program, and key results of Phase A Concept Definition Studies which extended from October 1980 to March 1982. (1) Phase B project definition activities beginning in April 1982 are described (2) to date including market studies, definition of proposed services, the MSAT system concept for the proposed baseline MSAT demonstration system, and the space and earth segments of this system. Planning for the Post-Launch Communications Program is also described.

Consultations have been taking place between the Canadian Department of Communications (DOC) and the US National Aeronautics and Space Administration (NASA) since 1981 to explore areas of common interest in the development of mobile satellite communications services and the advanced technologies required to implement such communications systems. It is anticipated that an Arrangement will be signed between DOC and NASA regarding cooperation in the MSAT Program.

At the present time serious considerations is being given to a proposed Canada-NASA cooperative MSAT program in which a US carrier, and Telesat in Canada would take the lead role in procuring, owning and operating the space segment of an initial two satellite system providing domestic service to both Canada and the US. For this proposal, the Department of Communications of Canada would support Telesat by securing a portion of the Canadian capacity for several years. This capacity would be used to conduct a planned post-launch communications program of user experiments and trials. In addition, the Department would support the development and initially provide a variety of mobile terminals for this post-launch program.

Although this paper focusses on a baseline government-led mission scenario, the recent increasing carrier interest in delivering mobile satellite services may well result in a lead role for carriers in Canada and the US for an initial system. These scenarios are being developed in detail by carriers and are not addressed here.

The primary strategic objective of the MSAT Program is to foster development of new mobile telecommunications services in Canada and to provide maximum related socio-economic benefit. In particular, the program is aimed at satisfying urgent national requirements for improved public and civil government mobile communications to under-served areas of Canada, including resource development activities in remote areas. Services will also be provided at 800 MHz to Data Collection Platforms for meteorological and geophysical data, and for monitor and control of various remote operations.

The objective of the Post-Launch Communications Program is to demonstrate both public and private mobile satellite services through experiments and trials to enable users to make a commercial viability decision, and to stimulate early market growth.

Implementation of this MSAT post-launch program is subject to future government approvals.

MARKET DEMAND FOR MOBILE SERVICES

Between October 1980 and March 1982, DOC sponsored 23 contracts with 15 Canadian companies to carry out Phase A (Concept Feasibility) studies on the MSAT Program. Principal study areas included market demand for MSAT services, commercial viability, user cost-benefits, and system and spacecraft concepts for an MSAT demonstration system for launch in 1988, as well as examination of various ground terminal requirements and related technology development.

Market Study Methodology

In 1981, DOC sponsored a Phase A market study of user requirements for a mobile satellite system operating at 800 MHz, as a first attempt to quantify the market demand for mobile-satellite service in Canada. (1) The study objectives were to project the number of MSAT users in the 1985-2001 time frame, and to determine potential MSAT service pricing.

The bulk of the data utilized in this initial study was developed from a survey of current users of mobile communications services in Canada. Mobile license data were used to define the total existing user population with a sample of these users selected for interviews. Sampling methodology ensured that all large users (i.e. those with 375 mobiles or more within one DOC regional district) were included in the sample and a random selection of smaller users was included, thereby providing a representative mix of users.

Personal and supporting telephone interviews were carried out with about 650 users throughout Canada. Additional study inputs were obtained from a review of previous mobile communications studies for Canada and the U.S., and contact with other knowledgeable sources such as equipment manufacturers, telephone companies and radio common carriers. Prediction of the potential MSAT market and the level of market penetration by MSAT was based on projecting growth for the relevant segment of the current total mobile communications market.

The potential MSAT market size was investigated in two stages. First, the Total Potential Market, representing all mobile communications users who could reasonably make use of MSAT services, was defined. Second, the "Market Penetration," represented by that proportion of the Total Potential Market that might actually use MSAT services, was estimated.

The Total Potential Market identified for MSAT consists of all users of mobile communications whose systems have a range of 50 miles radius or more and whose system usage within any single metropolitan area is more than 75% of usage outside areas with populations of 100,000 or more. Based on data currently available on the proposed satellite system and alternative terrestrial systems, this is considered a conservative cut-off point for the potential MSAT market.

Potential MSAT Market in 2001

In 1981, there were 410,000 licensed land-mobile radios in Canada, plus an additional 41,000 licensed ship and aircraft mobiles. Assuming a decline in growth rate over the next 20 years as penetration of the various industry sectors saturates, the total of mobile communications users in Canada was estimated at 1.1 million by 2001. Of this, the Total Potential Market for MSAT is expected to grow to 596,000 by 2001, with a total air time of 148 million minutes per average month.

MSAT Market Penetration

The scenario developed for the market share, or market penetration, available to MSAT assumed that, after a period of 15 years from the start of the demonstration phase, a satellite system would capture 50% of the new and replacement market for wide-area, non-metropolitan mobile communications. This includes mobiles associated with system replacements, mobiles added to expand an existing MSAT system, and those purchased by new-users. With this scenario, the MSAT units are expected to account for a projected 23% of the installed wide-area, non-metropolitan mobiles by the year 2001.

Figure 1 shows the projected MSAT market in Canada to year 2000. This market is divided among mobile radio (MRS), mobile telephone (MTS) and data services, with an initial estimate being 85 percent mobile radio and 15 percent mobile telephone and data services. Clearly data services constitute a major growth area.

The DOC initiated a follow-on Phase B Market Study (2) in 1982 with the objective of refining Phase A results by examining more particularly the potential market for new application areas not served by existing mobile services, and by studying the elasticity of the cost-demand relationship. These results will not be based on extrapolation of existing mobile license data as are Phase A results, but rather on extensive interaction with potential users.

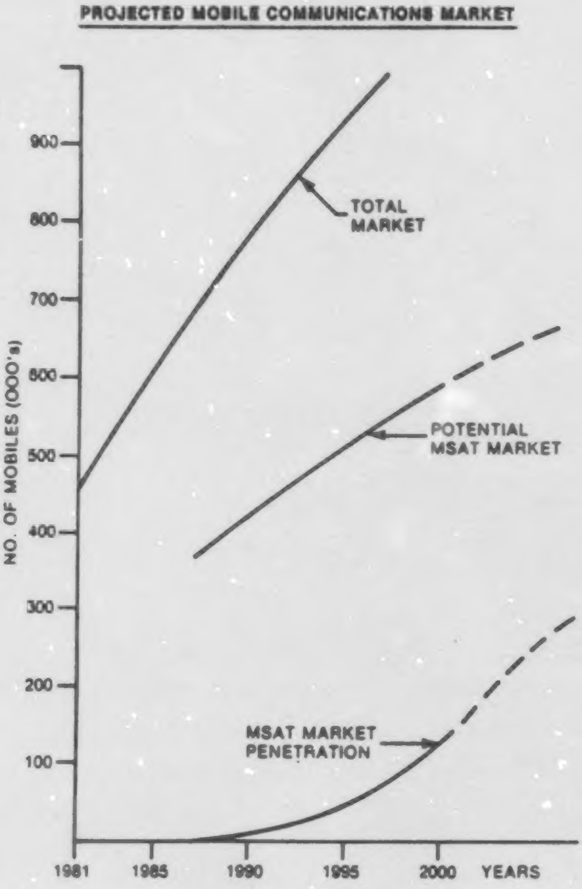
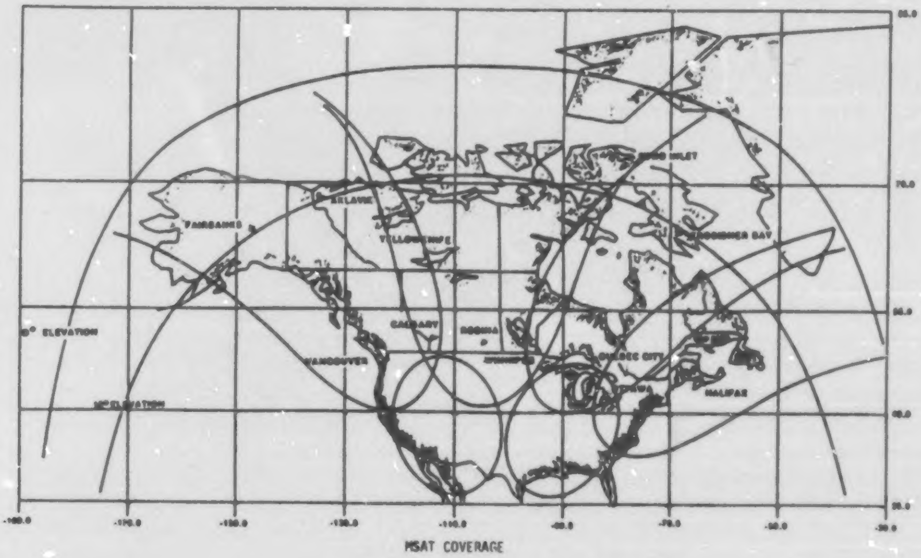


Figure 1

TABLE 1

SUMMARY OF CHARACTERISTICS OF THREE SERVICE CATEGORIES

CHARACTERISTIC	MRS	MTS	DATA
Two-Way Communication	Half Duplex Voice and Data	Full Duplex Voice and Data	Full Duplex Data
Access Limitation	MSAT Coverage	MSAT Coverage	MSAT Coverage
Terrestrial Interface	Private Network	Switched Network	Terrestrial Data Processing
Interoperability	MSAT Compatible Terrestrial Mobile Radio Systems	Terrestrial Cellular Systems	Terrestrial Cellular Systems
Protocol	MRS or User Defined	MTS Standard	Fixed Message Format
Data Capability	Up to 2.4 Kbps	2.4 or 4.8 Kbps	2.4 Kbps
Modulation	PELPS/DMSK or ACSSB	NBFM,PELPC,ACSSB	DMSK
Total RF Bandwidth	5KHz	5 or 30 KHz	-
Grade of Service	User Controlled (Dedicated channels)	Standard (TBD)	User Controlled
Transparency	Data Message Formats & Protocols	Data Message Formats & Protocols	
Control Service Access	N/A	N/A	Polled (Interrogated) Time Access, or Event Triggered


FAIRBANKS
INUVIK
YELLOWKNIFE
POND INLET
FROBISHER BAY
5° ELEVATION
CALGARY
REGINA
WINNIPEG
VANCOUVER
QUEBEC CITY
OTTAWA
HALIFAX
10° ELEVATION
70.0
-170.0
-150.0
-130.0
-110.0
-90.0
-70.0
-50.0
-30.0

MSAT COVERAGE
Figure 2

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COMMUNICATIONS SYSTEM CONCEPT

The baseline system concept for government-led MSAT mission is described in this section.

Positioned at a nominal longitude of 106.5°W, MSAT would be a geostationary satellite providing public mobile radio service (MRS), mobile telephone service (MTS) and data service (DS) to mobile and transportable terminals operating in the 806-890 MHz band. In addition, service from remote data collection platforms (DCPs) is planned to fixed locations. The demonstration system would be used in Canada to establish actual system parameters, confirm characteristics of a family of first generation terminals and conduct a Post-Launch Communications Program (PLCP) involving trials and experiments to build up a user community for service in the mid 1990's. In addition a maximum amount of interim commercial service would be realized from the initial MSAT system. The assumed user population, service types and community of interest are based on Phase A studies. However, the spacecraft transponder is designed to be transparent to types and numbers of users within the overall constraint of satellite power and bandwidth, thus maximizing system flexibility. (3)

Traffic and Service Characteristics

The three broad categories of service have characteristics which are summarized in Table 1.

The sharing of traffic over a relatively small number of channels in the MSAT system is optimized by assignment of channels on a demand (i.e. DAMA) rather than preassigned basis.

The MTS traffic load would be served through a flexible channel grouping because of different bandwidth and modulation requirements and also due to the difference in call processing protocols between MRS and MTS. Mobile radio service in Canada, as opposed to telephone services, have been traditionally obtained through systems serving narrow community interests. Most MRS users have been served by privately owned or leased systems providing service to groups of stations operated for the sole benefit of a major customer.

System Architecture

Basic Canadian service requirements include national coverage for domestic service to the 200 mile offshore limits and as far north as feasible. Due to limited availability of 806-890 MHz spectrum for mobile-satellite service and an MSAT system requirement to demonstrate frequency reuse, a minimum of four Canadian beams are required. For Canada coverage with a reasonable degree of overlap to permit off loading of traffic from loaded beams to adjacent beams, the spacecraft antenna beamwidth was selected as 2.7°, corresponding to a 9.1M antenna at 866 MHz. This coverage is shown in Figure 2, with two US beams included to reflect earlier NASA requirements.

The present system concept allows all mobile terminals having greater than 10° elevation angle to the satellite to sustain reliable communications using 4dB gain mobile antennas. For northern locations having less than 10° elevation to the satellite, it is expected that higher gain mobile terminal antennas will have to be employed, making the use of transportable terminals more likely in these areas.

Gateway stations are planned in each beam to provide interface with the Direct Dial Network (DDN), as terrestrial access points for MRS, and as system switching and access control facilities. To reduce satellite loading, circuits will be either push to talk or voice activated, with MRS being half duplex and MTS full duplex.

The Gateway satellite link will operate in the 13/11 GHz SHF band while the mobiles will uplink to the satellite at 821-825 MHz and downlink at 866-870 MHz. Routing through the satellite would be under gateway control and may be either double hop UHF-SHF-SHF-VHF, or single hop UHF-UHF, UHF-SHF or SHF-UHF. For network control, signalling and interbeam routing Gateways will use SHF-SHF links. Figures 3,4, and 5 illustrate typical MRS and MTS scenarios.

To meet traffic loading including the double hop requirements for the four-beam satellite, 17 channels/beam are required for MTS, 36 channels/beam for MRS routed UHF-SHF and 48 channels/beam for MRS routed UHF-UHF. Additional capacity is required for signalling.

UHF Frequency Requirements

This MSAT baseline system design would require 930 KHz per beam on the uplink and downlink for traffic channels. With allowance for guardbands and signalling channels, it is estimated that 1.1 MHz/beam would be required. Using a frequency reuse factor of 3, 3.3 MHz of useable bandwidth would be required for the total effective Canadian uplink and downlink of 4.4 MHz.

Modulation Techniques

Three modulation techniques are being considered for mobiles (4): 30 KHz Narrow-Band FM (NBFM), 5 KHz 2.4 Kb/s Pitch Excited Linear Predictive Coding (PELPC) with Differential Minimum Shift Keying (DMSK), and Amplitude Companded Single Sideband (ACSSB).
The MTS service will use NBFM with toll quality given as a noise equivalent not greater than 52.0 dBrnCo, corresponding to an unfaded carrier to noise density ratio of 58.0 dB-Hz. Minimum quality, which is expected to occur only 1% of the time, is given as a noise density ratio of 45.0 dB-Hz. Companding will be used to improve the subjective signal to noise ratio. ACSSB and PELPC will be assessed for the MRS and future MTS application with minimum quality expected at 39.0 dB-Hz and 40.0 dB-Hz, respectively. Reduction of required bandwidth using these modulation techniques will contribute significantly toward the viability of the system.

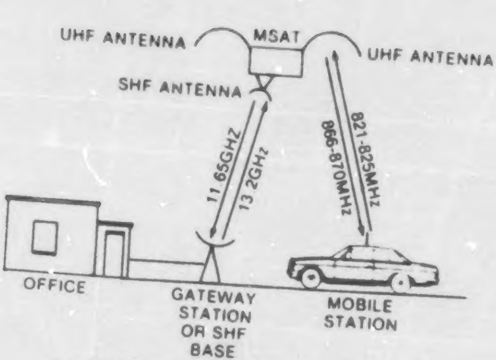
Link Budget

The two dominant factors in establishing the propagation margin at 800 MHz for mobile service are multipath and shadowing of the mobile-satellite path by terrain obstacles (5,6). Extensive measurements have been made of the fading characteristics of mobile terrestrial systems operating at these frequencies. However, only limited data are available for the satellite terrestrial circuit. Based on experiments that have been conducted in non-urban areas, a propagation margin of 13 dB is expected to provide service for 99% of the time, in typical Canadian environments.

In the allocation of noise contribution to the uplink, satellite, and downlink, attention must be given to the power critical UHF satellite to mobile path. To minimize UHF PA loading the downlink is made the major noise budget contributor. A practical approach is to limit the satellite contribution, C/Io (intermodulation, interbeam interference, spurii,etc.), to an overall reduction in $C/(No)_t$ of 0.5dB. This results in

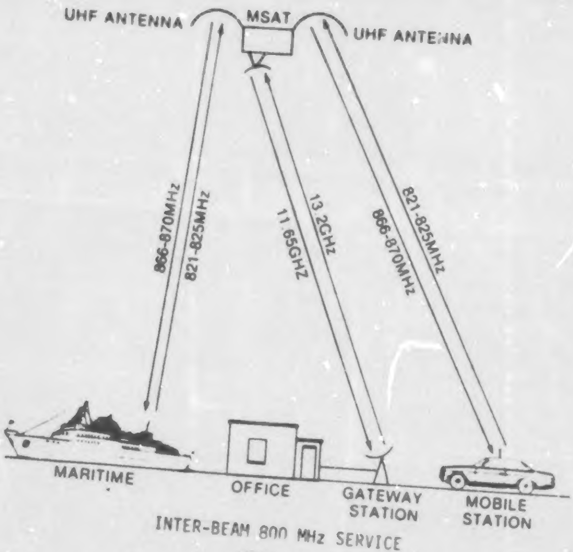
$$C/Io = C/(No)_t + 9.6\text{dB-Hz}$$

where $C/(No)_t$ is the reference total link carrier-to noise density ratio. Therefore, C/Io (the satellite noise contribution) represents approximately 11% of the overall noise budget. Using the same value for uplink noise, the overal link budget is: uplink 11% (9.6dB), satellite 11% (9.6dB), and downlink 78% (1.1dB) above $C/(No)_t$. With the same percentage noise allocation for the SHF C/Io (11%) and adjusting uplink and downlink thermal noise contributions to 59%, and 30%, respectively, results in 12.3dB, 9.6dB, and 5.2dB above the required $C/(No)_t$. Transponder gain is set for the analog modulation, and the relative thermal noise contributions are adjusted for the digital modulation while keeping Io constant.


UHF ANTENNA
MSAT
UHF ANTENNA
SHF ANTENNA
11.65GHz
13.2GHz
866-870MHz
821-825MHz
OFFICE
GATEWAY STATION OR SHF BASE
MOBILE STATION

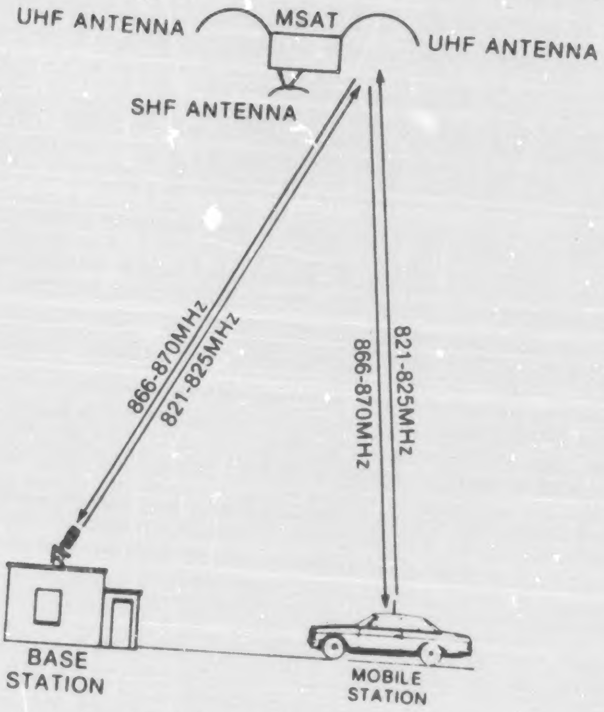
SHF/UHF 800 MHz SERVICE

FIGURE 3


UHF ANTENNA
MSAT
UHF ANTENNA
866-870MHz
821-825MHz
11.65GHz
13.2GHz
866-870MHz
821-825MHz
MARITIME
OFFICE
GATEWAY STATION
MOBILE STATION

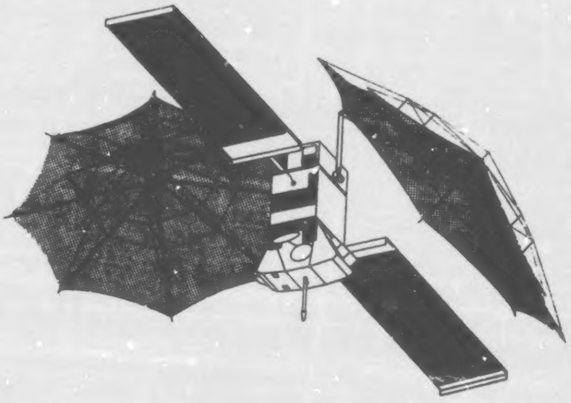
INTER-BEAM 800 MHz SERVICE

FIGURE 5


UHF ANTENNA
MSAT
UHF ANTENNA
SHF ANTENNA
866-870MHz
821-825MHz
866-870MHz
821-825MHz
BASE STATION
MOBILE STATION

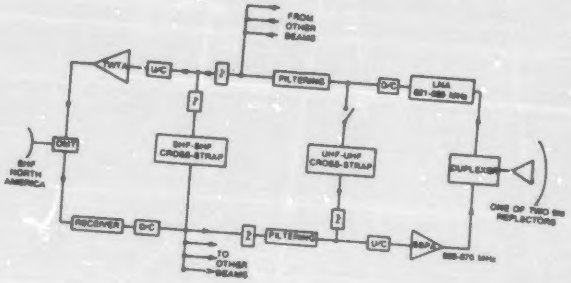
UHF/UHF 800 MHz SERVICE

FIGURE 4



MSAT CONCEPTUAL VIEW

FIGURE 6


FROM OTHER BEAMS
TWTA
U/C
FILTERING
D/C
LNA 821-825 MHz
SHF-SHF CROSS-STRAP
UHF-UHF CROSS-STRAP
OMT
SHF NORTH AMERICA
DUPLEXER
ONE OF TWO 5M REFLECTORS
RECEIVER
D/C
FILTERING
U/C
SSPA
866-870 MHz
TO OTHER BEAMS

SIMPLIFIED TRANSPONDER BLOCK DIAGRAM

FIGURE 7

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SPACE SEGMENT

Platform

The payload requirements described imply the use of a large spacecraft to satisfy a 7 year MSAT mission. Following an examination of various candidate platforms during Phase A, use of an LSAT (Olympus) platform with minimum changes from British Aerospace Ltd. was adopted in Phase B in the MSAT spacecraft baseline design.(7) Much of Phase B spacecraft definition work has focussed on this platform, which has considerable growth potential for follow-on systems. These will employ larger antennas to achieve greater frequency reuse to meet the increasing market demand. A conceptual view of this spacecraft is shown in Figure 6.

The baseline platform design is driven primarily by the requirement to carry 2 large (9.1m) reflectors, and also by the transponder high-power amplifiers, which together impact the structgural, attitude control, thermal and power subsystems.

A major platform structure requirement is for the support of large reflectors and feeds which rely on structural stiffness to maintain their relative positions and antenna pointing. The existing East/West structure design for LSAT has adequate stiffness to carry antenna masses less then 45 which should be possible with Harris reflectors.

The power subsystem must sustain demand peaks due to power amplifier loading, and minimize solar array shadowing by the 9.1m reflectors. It would be necessary to replace the present LSAT batteries (25 AH NiCd, 35 AH NiH$_2$) with two 50 AH NiH batteries. The existing LSAT array designed fo 3.3 KW at 7 year end of life (EOL) should prove adequate without modification.

The LSAT attitude control subsystem requires change mainly in the location of sensors and thrusters in order to minimize plume impingement on the reflectors.

A flexible and robust thermal subsystem is needed to accommodate a very large variation of 800 MHz power amplifier dissipation, with this being maximum near end of life. Variable conductance heat pipes were chosen to avoid excessive heater switching.

A major difference between LSAT and MSAT is the proposed launch vehicle, which is STS for the MSAT baseline, rather than Ariane. A Transfer Orbit Stage (TOS) has been chosen as a perigee stage. It is possible to retain the same propellant tanks and avoid major structural changes and include full North/South stationkeeping for a dry mass of about 1460 Kg.

If large tanks were used and the structure requalified, then up to 2200 Kg of fuel can be carried and up to 600 Kg payload mass. Much larger reflectors could then be carried, with up to 7 Kw generated from an extended array, for growth versions of the spacecraft.

Communications Payload

The communications payload has been designed by SPAR Aerospace Ltd. and the simplified transponder block diagram is shown in Figure 7. Two independent feed systems are used to excite the two 9.1m reflectors. This antenna arrangement minimizes any losses due to sharing feed apertures for adjacent beams and provides a balanced antenna structure. Frequency reuse is achieved between the Canadian W and E beams which are fed by separate horns. The interior Canadian beams are fed from another pair of feed horns, which must be shared to add two antenna beams to the US, as originally required by NASA. Orthogonal polarization would be employed between Canadian and US beams.

The gain in each transponder path is independently adjustable in 1 dB steps over 20 dB. Each Canadian beam has 1.1 MHz overall bandwidth with 250 KHz filtered for the UHF-UHF cross-strap. The UHF LNA has a 1.5 dB noise figure and the SHF receiver has a 1 dB noise figure. The edge of coverage (EOC) net gain on the UHF transmit antenna at 866-870 MHz is 30.4 dB, with a receive G/T of 3.4 dB/°K at 821-825 MHz, including all losses and system margin.

At end-of-life in the busy hour the UHF solid state power amplifier operates at an average level of 19.3 dBW.

Spacecraft Summary

total power available (solstice)	3128 W
payload mass	555.7 Kg
spacecraft dry mass	1459.8 Kg
spacecraft wet mass (transfer orbit)	3385 Kg
spacecraft launch mass (STS)	17565 Kg
spacecraft maximum dimensions	
solar array tip-to-tip	24.7 m
UHF reflector edge-to-edge	22.9 m

EARTH SEGMENT

The MSAT Earth Segment comprises a group of terminals designed primarily to meet the various service requirements, as well as to evaluate new or emerging technology in mobile communications. While in some cases, these terminals can take advantage of existing technology to develop optimized satellite terminals, a considerable amount of new technology development will be required. The principal characteristics of these terminals are described. Possible areas of technology development are identified, and current MSAT baseline concepts are presented.

Central Control Station (CCS)

This is the primary and most complex terminal which will provide two major functions. Firstly, it will form the primary Tracking, Telemetry and Control (TT&C) Facility for satellite monitoring and control. Secondly, it will be used as the central monitor and control facility for the various communications services. Overall system control will be maintained and the responsibility for ensuring system integrity of the various communications services will be located in the Central Control Station. The Central Control Station will control the demand assignment of channels for each of the services and will most likely house the Network Management System. For the demonstration system, it is possible that the CCS will be manned and not the gateway stations.

The Network management System (NMS) will optimize system utilization, maintain and analyze network data, and reconfigure the network status. Status information will be fed to the NMS from gateway stations via the SHF-SHF links and from the satellite telemetry data forwarded from the Central Control Station. Historical logs, as necessary, will be kept for future analysis. Commands (load shedding, user beam allocation, etc.) to the gateways will be forwarded via the SHF-SHF link. Requests for transponder reconfiguration (gain settings, UHF-UHF routing, etc.) will be sent to the Central Control Station. System wide alarm status will also be maintained. The NMS may be co-located with the Central Control Station or master gateway depending on technical and financial factors.

Gateway Stations

Present system concepts provide for one gateway station per beam in the MSAT demonstration system. These stations will transmit and receive at the 13/11 GHz backhaul frequencies. Under overall supervision of the CCS, they will provide automatic interface to the Switched Telephone Network (STN) for mobile telephone services and monitor terminal performance in their beam. Each gateway station will be equipped with an SHF transceiver with a 5 m antenna, a 2 dB NF LNA, a 50-watt TWTA, a variety of channel units compatible with mobile radios in its service area, and will be capable of operation on any of the assignable frequencies under remote control. Present planning anticipates that the CCS will be colocated with the master gateway stations.

Base Stations for Mobile Radio Service

The primary function of the base station is to provide a local MSAT access for service to a specific set of MRS users which may operate as a private network. These stations will operate under DAMA control and will request channels, as required, from the master gateway station (except where the base station is operating on pre-assigned channels).

Automatic interconnection to the Switched Telephone Network (STN) will normally not be provided. The base station will utilize either a UHF or SHF signalling channel, and will operate with its mobiles in a half-duplex mode.

Both UHF and SHF base stations are planned with the base station operating at UHF being implemented at much less cost and complexity than an SHF base station. For a single-channel UHF base station, the equipment required would be essentially the same as a field-portable terminal.

Mobile User Terminals(4)

As indicated earlier, a family of mobile terminals employing three different modulation schemes is presently being defined for the MSAT program. These include land, sea and air mobile terminals as well as field portable terminals.

This will transmit in the 821-825 MHz band and receive in the 866-870 MHz band. MTS will initially be provided by NBFM modulation although it is anticipated more spectrum and power efficient technique like ACSSB and DMSK/LPC will eventually become user acceptable thus decreasing the channel bandwidth from 30 KHz to 5 KHz.

A major mobile terminal definition study is underway for each of these modulation techniques. At the present time it is intended to employ 4 dBic gain antennas for mobile terminals having reasonable satellite elevation angles, and 10 dBic gain antennas for transportable terminals used for data collection or in the far north. All terminals will use 2 dB noise figure front ends.

An average value of 220°K antenna temperature was measured for a prototype drooping dipole antenna applicable to an 800 MHz vehicular terminal. An overall system noise temperature of 509°K or 27.1 dB/°K was estimated allowing for cabling and filter losses, and for a 4 dBi gain antenna, the receive G/T is - 23.1 dB/°K. To meet system EIRP requirements with a 1dB loss between transmitter and antenna, transmitter power outputs of 2.0 w and 2.1 w for DMSK/LPC and NBFM respectively, will be required from the mobile terminals.

For the field portable or transportable terminal, it was assumed conservatively that the noise temperature would be no worse than for the vehicular terminal or 27.1 dB/°K . With 10 dBi antenna gain and proper siting to avoid shadowing and multipath, the transportable terminal will enjoy improved communications reliability over that for the vehicular terminal. To preserve a favourable intermodulation environment, it is assumed that signals of a given service type will pass through the satellite at the same level, irrespective of terminal type from which they may originate.

An important area of technology development is the vehicular antenna which must have as high a gain as possible consistent with cost. Multipath rejection is also very important. A second important area for development is the low-cost stable frequency synthesizer needed for demand assigned terminals. Maintaining long term oscillator stabilities of 5 parts in 10^7 for 5 KHz channels in the face of doppler variations will most probably be resolved by assigning a pilot reference carrier.

Data Collection Platforms

The Data Collection Platform (DCP) Service will be provided in the 821-825 MHz uplink band, and received by Gateway or Central Control Stations in the 11.65 - 11.70 GHz downlink. This one-way data service will be expanded from that at 400 MHz in that non-geophysical data will also be carried, and will constitute a portion of the more general two-way data service for monitor and control. This service and terminals are presently in definition.

POST LAUNCH COMMUNICATIONS PROGRAM (PLCP)

A Post Launch Communications Program for MSAT consisting of trials, demonstrations and experiments is presently being defined to encourage a wide variety of user applications to be assessed to allow viability decisions to be made regarding a commitment to subsequent interim-commercial or commercial MSAT service. This post-launch program will be instrumental in refining service offerings, in establishing market demand and in creating a maximum early service demand.

To date extensive contact has been made with a wide variety of potential public and private users across Canada, with indication of a strong interest in participation in the MSAT Post Launch Communications Program. In the event of an initial carrier-led MSAT system, it is expected that the Department of Communications would secure satellite capacity to conduct this Post Launch Communications Program in cooperation with Telesat Canada.

CONCLUSIONS

The baseline mobile satellite system (MSAT) described in this paper could with minor modification be launched in 1988 as an initial national or regional system to serve a large potential mobile communications satellite market in rural and remote areas. It is expected that the market would be sufficiently strong to support a second generation system in the mid 1990's. The initial system would provide a platform to develop and evaluate new power and spectrum efficient techniques suitable for future satellite and terrestrial voice and data services.

ACKNOWLEDGEMENT

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MOBILE SATELLITE COMMUNICATIONS

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1. Abstract

The International Maritime Satellite Organization (INMARSAT) operates the world's only commercial mobile communications satellite system. The system was established to provide satellite communications to the world's shipping and offshore industries, although other uses were foreseen. This paper outlines why INMARSAT was established, how the system works and how it can be used. It also reviews some of the new services which INMARSAT could provide with the introduction of its second-generation satellite system in 1988.

2. WHY INMARSAT WAS NEEDED

Since the 1965 launch of Early Bird, the first commercial communications satellite, space-age technology has had a dramatic impact on the way the nations of the world communicate. Television, radio and telecommunications delivered via satellite now put people from around the globe in touch with each other in seconds. Until recently, however, this technological marvel was largely confined to the enjoyment of people on land - even though there has long been a need to extend the power of satellites to people at sea.

It was for this reason that, soon after the launch of Early Bird, maritime nations began to consider how satellites could be used to provide reliable communications to and from ships. They recognized that conventional radiocommunications on the MF, HF and VHF bands, although much improved over the years, cannot effectively meet all modern shipping requirements. They are still subject to the vagaries of ionospheric and other disturbances, as well as a lack of an adequate number of channels, making contact often difficult and sometimes impossible. Delays of many hours and even days occur, particularly in long-range communications. At times of maritime disaster, such delays have in the past and may in the future lead to loss of life and property.

In 1971, the World Administrative Radio Conference for Space Telecommunications allocated frequency bands to the maritime mobile satellite service. Four years later, the International Maritime Organization (IMO) convened the first of three sessions of the International Conference on the Establishment of an International Maritime Satellite Organization. IMO identified several reasons why such a system should be established. Among them:

- to relieve congestion in the MF and HF bands;
- to improve reliability, quality and speed of communications;
- to improve geographical coverage and continuous availability of services;
- to permit automation of radiotelephone and teleprinter;
- to cater for services not possible in the MF and HF bands, such as high speed data transmission;
- to improve distress, urgency and safety communications.

IMO held the final session on 3 September 1976, at which time the Conference unanimously adopted the Convention and Operating Agreement on the International Maritime Satellite Organization.

With its headquarters in London, INMARSAT came into existence on 16 July 1979 and began operations on 1 February 1982. Forty countries have now joined the international Organization (Table 1).

3. INMARSAT'S PURPOSE

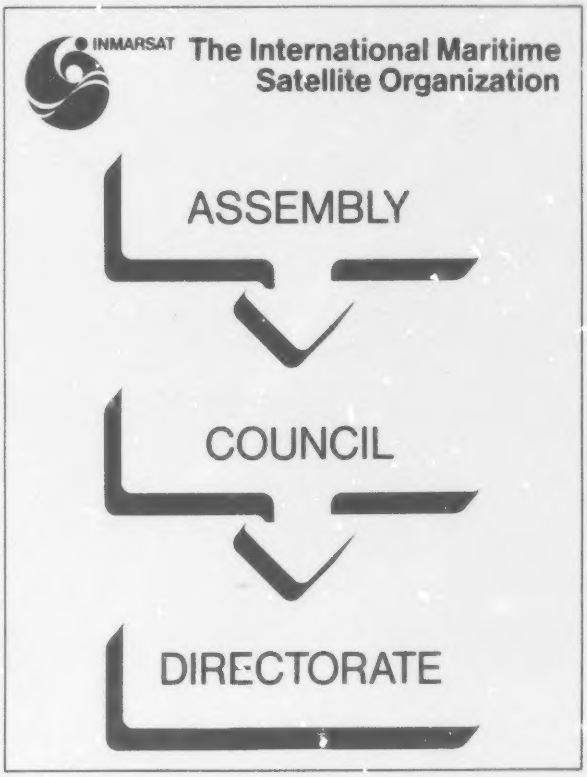
According to its Convention, INMARSAT's purpose is "to make provision for the space segment necessary for improving maritime communications, thereby assisting in improving distress and safety of life at sea communications, efficiency and management of ships, maritime public correspondence services and radiodetermination capabilities." The Convention also says that INMARSAT shall act exclusively for peaceful purposes, that it is open for membership by all States and that ships of all nations may use the space segment.

4. STRUCTURE AND FINANCING

Established to "operate on a sound economic and financial basis, having regard to accepted commercial principles", INMARSAT is financed by the Signatories to its Operating Agreement. The Signatories have been designated as such by the member countries. For the most part, the Signatories are national telecommunications carriers.

The Signatories come from the rich and the developing nations, from East and West. Those Signatories with the largest investment shares are from the U.S., Soviet Union, the UK, Norway and Japan. The investment share is intended to reflect the actual utilization of the INMARSAT system. The investment covers the costs of the space segment and the operating and administrative costs of the Organization. The total of all capital invested by the Signatories, plus compounded compensation at 14 per cent a year is to be returned to Signatories as the system becomes profitable. INMARSAT could break even as early as 1984, much earlier than its original forecasts, in part because the number of users of the system is growing more rapidly than was expected.

INMARSAT has a three-tier organizational structure (Figure 1):



* The Assembly of Parties (or States) meets once every two years to review the activities and objectives of INMARSAT and to make recommendations to the Council. All member States are represented and have one vote each.

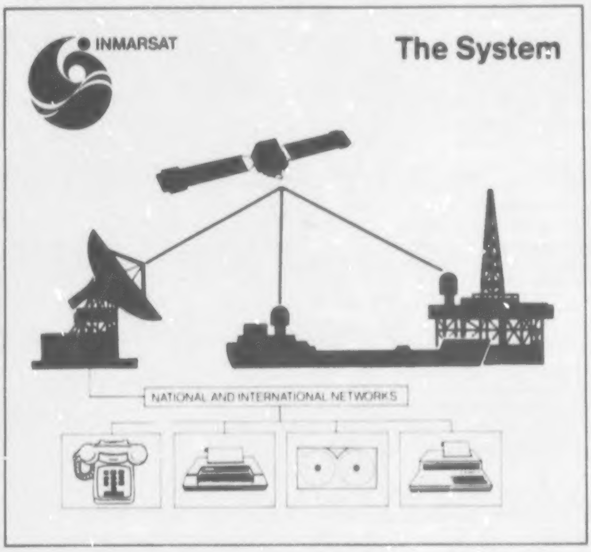
* The Council of Signatories is like a corporate board of directors; it is INMARSAT's policy-making body. It consists of 22 Signatories: 18 with the largest investment shares and four others elected by the Assembly on the principle of a just geographical representation and with due regard for the interest of developing countries. The Council meets at least three times a year and each Signatory has a voting power equal to its investment share.

* The Directorate carries out the day-to-day activities of the Organization. The Director General is INMARSAT's chief executive officer.

5. THE INMARSAT SYSTEM

The INMARSAT satellite system is somewhat different from those of other satellite organizations which provide a fixed service. INMARSAT interfaces directly to the end-user's telephone on the mobile side of the satellite. It extends the terrestrial telecommunications networks to the oceans of the world. When someone on board a ship picks up the telephone, he is, in effect, using the ultimate in cordless telephones.

The maritime satellite system has three major components: the satellite capacity leased by the Organization, the coast earth stations and the ship earth stations (Figure 2).

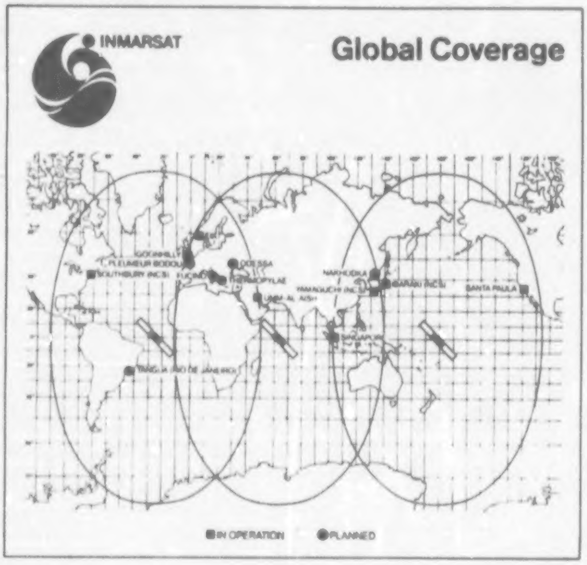


The nerve centre of the system is the Operations Control Centre (OCC) at INMARSAT's headquarters. The OCC is connected directly by its own ship earth stations to the Atlantic and Indian Ocean satellites, and so to all coast earth stations around the world. Operating 24 hours a day, 365 days a year, it co-ordinates a wide range of activities. Should a serious problem arise with one satellite, putting it out of commission, the OCC would be responsible for taking the necessary steps to transfer traffic to an in-orbit spare. The OCC also handles all commissioning applications from ships which have just installed INMARSAT terminals.

6. THE SATELLITES

The INMARSAT satellites are in geostationary orbit, 36,000 kilometres above the equator, over the Atlantic, Indian and Pacific Oceans, and provide near-global coverage (Figure 3). There are both operational and back-up satellites. Thus, if one satellite should fail, another in-orbit spare will be able to take over immediately.

As of October 1983, INMARSAT had leased two Marisat satellites, each with a capacity of about 10 telephone channels, from the Marisat Joint Venture (the principal shareholder of which is Comsat General of the U.S.); a Marecs A satellite, with a capacity of about 40 telephone channels, from the European Space Agency; and maritime communications subsystems (MCS), each with a capacity of about 30 telephone channels, on the Intelsat V F-5 and F-6 satellites. In the next year or so, it plans to lease capacity on three more satellites.



By ocean region, the satellite configuration is as follows:

Atlantic	Marecs A	— operational
	Intelsat V MCS-B	— in-orbit spare
Indian	Intelsat V MCS-A	— operational
	Marisat F-2	— in-orbit spare
	Intelsat V MCS-C	— available late 1983
Pacific	Marisat F-3	— operational
	Intelsat V MCS-D	— available early 1984
	Marecs B2	— available late 1984

Maritime satellite communications provide a number of advantages over conventional radio-telephony and radio-telegraphy. Among them are:

- instantaneous, high-quality service at any time of the day or night, unaffected by weather or ionospheric disturbances;
- improved emergency reporting, with priority access to INMARSAT satellites for distress alerts;
- interconnection of services to the worldwide public telecommunications networks;
- direct dial capability for voice and telex communications;
- privacy of communications;
- near-global coverage (to the 75 degree latitudes);
- ship-board equipment which is simpler and easier to use and which does not require lengthy or expensive user training.

7. COAST EARTH STATIONS

The coast earth stations provide the link between the satellites and the telecommunications networks ashore. The coast earth stations are owned and operated by Signatories, who are also responsible for the landline connections to the public switched telephone and telex networks. A typical coast earth station consists of a parabolic antenna about 11-14 m in diameter, which is used for transmission of signals to the satellite at 6 GHz and for reception from the satellite at 4 GHz. The same antenna or another dedicated antenna is used for L-band transmission (1.6 GHz) and reception (1.5 GHz) of network control signals. Each coast earth station provides, as a minimum, telex and telephone services. As well, three coast earth stations — at Southbury, Connecticut, and at Yamaguchi and Ibaraki in Japan — serve as Network Co-ordination Stations, which assign telephone channels, on demand, to ship earth stations.

As of October 1983, eight INMARSAT coast earth stations were in operation around the world, and their number is expected to more than double by the end of 1984.

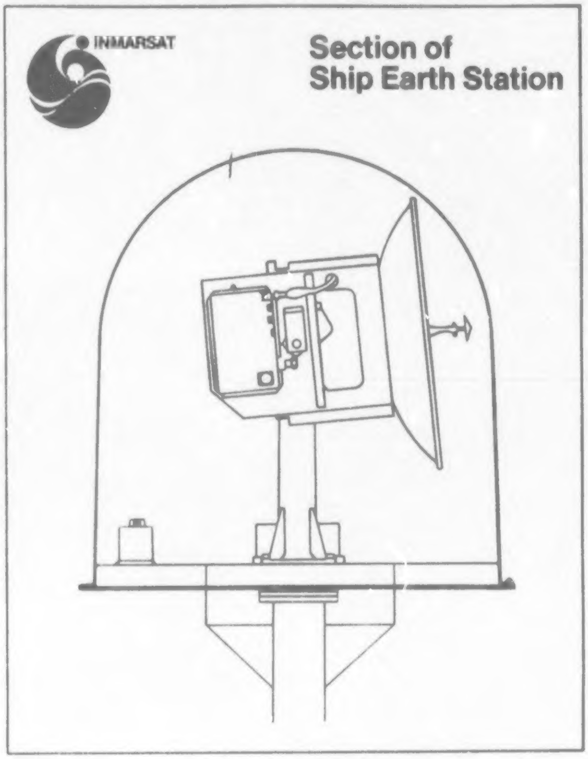
INMARSAT COAST EARTH STATIONS

Ocean Region	Location	
In operation		
Atlantic	Southbury, Conn., U.S.	
Atlantic	Goonhilly, U.K.	
Atlantic	Umm-al-Aish, Kuwait	
Indian	Yamaguchi, Japan	
Indian	Eik, Norway	
Pacific	Santa Paula, Calif., U.S.	
Pacific	Ibaraki, Japan	
Pacific	Singapore	
Under construction		Ready for service
Atlantic	Fucino, Italy	late 1983
Atlantic	Odessa, USSR	late 1983
Atlantic	Pleumeur Bodou	late 1983
Atlantic	Tangua, Brazil	late 1983
Indian	Odessa, USSR	late 1983
Indian	Thermopylae, Greece	mid 1984
Indian	Nakhodka, USSR	late 1984
Pacific	Nakhodka, USSR	late 1984

The additional coast earth stations will shorten the terrestrial distance a call has to travel to and from ships and offer the opportunity to reduce user charges. The cost of placing a call varies from country to country, as one might expect, since end-user charges for INMARSAT services are set by telecommunications administrations. For ship-to-shore calls, the Signatory operating the coast earth station bills the user's designated accounting authority. Billing for shore-to-ship calls is the responsibility of the telecommunications administration providing service via INMARSAT. INMARSAT in turn earns its revenues by billing the Signatories who operate the coast earth stations for the use made of its satellite system.

8. SHIP EARTH STATIONS

The ship earth station, which puts the ship-board user in instant contact with the rest of the world, consists of two parts, the above-deck and below-deck hardware. The above-deck equipment consists of a parabolic antenna, typically between 0.8m and 1.2m in diameter, housed in a fibreglass radome which protects the dish from the ravages of the maritime environment (Figure 4). The antenna is mounted on a stabilized platform, enabling the antenna beam to remain pointed at the satellite regardless of ship course or movement. Signals are transmitted to the satellite at 1.6 GHz and received at 1.5 GHz.



The below-deck equipment consists of telex and telephone and a variety of optional equipment for facsimile, data and slow-scan television. Low and medium-speed data transmission is available via a voice channel at up to 4800 bits per second in both directions. With a specially prepared satellite channel in the ship-to-shore direction, high-speed data transmission at up to 56 kilobits per second is also available. The ship earth station can be powered by the ship's electrical system and/or batteries.

INMARSAT has developed comprehensive type approval procedures with a view to ensuring proper operation of all ship earth stations in the INMARSAT system. As a consequence, most national licensing authorities in the INMARSAT member countries automatically type accept these SES models without requiring additional testing.

Calls are placed to and from ships in virtually the same way -- and just as quickly -- as one would make a call from the home or office. When a user on board a ship places a telephone call, he pushes a request button on his below-deck communications equipment which sends a signal via satellite to a network co-ordination station (NCS). The NCS then assigns a voice channel from a "pool" of available circuits for use by the ship for that call. Telex channels, however, are assigned by the coast earth station. In both cases, channels are assigned automatically and in the matter of seconds. The user then dials the number he wants. Each ocean region has the equivalent of a country code.

INMARSAT gives distress communications priority access to the space segment. In distress cases, a special button on the ship station may be pressed to provide immediate telex or telephone communication to the desired coast earth station which then puts the ship into contact with the appropriate rescue co-ordination centre.

Ship earth stations can be purchased from 10 different manufacturers around the world. Prices are competitive at about U.S. $35,000. They provide:
- automatic reception of telex and telephone calls;
- initiation of telex and telephone calls;
- reception of group (broadcast) calls from shore.

On acceptance of call requests or when a call is received, lamp and/or audio warnings are given automatically.

Manufacturers of ship earth stations are producing a new generation of equipment that is smaller and easier to use than earlier models. Most of the current systems are modular in design and can easily be upgraded by the addition of new capabilities. A typical below-deck unit consists of a micro-computer with a visual display unit (VDU) and alphanumeric keyboard, hard copy printer and telephone with a modem. The micro, with VDU, provides automatic and visual prompting of communications and control functions eliminating the need for reference to an operator's manual. The VDU displays system status and allows the operator to prepare telex messages with the ease of modern word-processing equipment. Messages can be composed, edited and transmitted directly from the screen or stored for later transmission. As well, the micro can memorize the satellite's co-ordinates and coast earth station tariffs and can automatically route the call the most economical way.

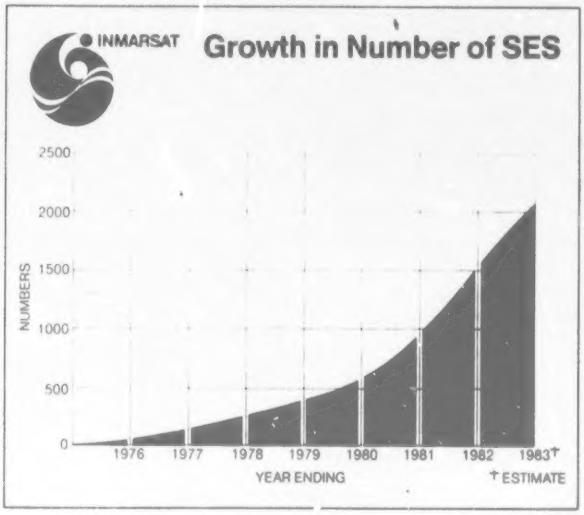
A telephone call via maritime satellite is, at present, nominally more expensive than via conventional communications. If, however, speed of establishing the call and the quality, vital for data transmission, are taken into consideration, then the satellite call is cheaper. In the next few years even the nominal cost differential should develop in favour of satellite communications. Satellite telex is already considerably less expensive than Morse telegram.

For the time being and probably until the early 1990s, the Standard A ship earth station, an analog terminal, is likely to remain the all-purpose workhorse of the INMARSAT system.

Development work is, however, proceeding on other possible standards, to meet the needs of high and low-volume users. These new standards could reach the market at about the same time as INMARSAT's second-generation satellite system, in 1988. INMARSAT is, however, conscious of the fact that there is little to be gained from proliferating a large number of new and different standards for which there is no viable market.

9. APPLICATIONS AND USERS

The number of ships, offshore drilling rigs and others using the satellite system increased by about 60 per cent in INMARSAT's first year of operations (Figure 5). As of 1 October 1983, there were 2,026 users, including oil tankers, liquid natural gas carriers, offshore drilling rigs, seismic survey vessels, fishing boats, cargo and container vessels, passenger ships, icebreakers, tugs, cable-laying ships and even a replica of a Viking ship. The maritime satellite system is also used by research teams in the Antarctic, a weather station in northern Greenland and, on an exceptional basis, by oil production platforms.



As might be expected from such a range of users, the range of applications of satellite communications is equally wide.

* Offshore oil rigs equipped with satellite terminals can transmit well log data to land-based computers for rapid analysis. Until satellite communications became available, they had to use helicopters to transport the data back to shore.

* Ship operators can use the system for the rapid transmission of data on engine performance, fuel consumption, position-reporting, weather conditions and provisioning.

* Cargo and container vessels and oil tankers can obtain berthing and scheduling information in advance of arrival in port. If there are delays in port, the ship can adjust its estimated time of arrival or be diverted to another port.

* Tuna and other fishing fleets use the satellite system because it ensures privacy of communications. One boat does not have to share its knowledge of where the fish are with vessels outside its fleet.

* If a vessel breaks down at sea, engineering drawings can be transmitted by facsimile to enable repairs to be carried out. If necessary, spare parts can be ordered by satellite and be waiting in the next port to minimize the time spent waiting for the repairs to be carried out.

* Ships of a particular fleet or national group can receive a common telex message through INMARSAT's facility for shore-to-ship group ("broadcast") calls. Facilities also exist for group calls to ships in a defined geographical area within each ocean region, which is particularly useful for broadcasting weather forecasts and navigational warnings.

* Crew members can make telephone calls in privacy at any time to their families back home, which is an obvious improvement in quality of life on board.

* Passenger liners can be sent passenger lists in advance of their next voyage and can transmit requests for additional provisions. Passengers can call their homes and offices.

* Satellites may even play some role through improved and rapid communications in alleviating congestion, accidents and pollution in ports.

Safety of life remains a preoccupation for mariners; they can be assured of virtually instant contact through the INMARSAT system with shore or other authorities in the event of an emergency. This is particularly important in view of the fact that serious casualties continue to occur with almost monotonous regularity, at high cost in loss of lives and property and in pollution of the oceans. Tankers alone accounted for 1,004 serious casualties throughout the world in the 12 years 1968-1980, with 1,593 lives lost in casualties involving tankers, liquid natural gas carriers and combination carriers.

And as for medical emergencies, Robert C. Parrow, a retired U.S. Coast Guard Commander, has said, "A lengthy study done by the U.S. Coast Guard revealed that 10 per cent of shipboard requests for medical advice ended in fatalities, that seven per cent of the victims could have been saved - and that the biggest single problem was poor communications." With a satellite terminal, however, users now have at their fingertips an instant and high-quality link with shore which can be used to transmit medical data.

A related application of INMARSAT is for disaster relief. A step toward a much-needed global disaster relief communications system was taken in 1982 when INMARSAT granted access to its satellite system for emergency relief operations on land. Disaster relief agencies are able to use portable earth stations in areas where conventional communications have been destroyed by fire, flood or earthquake or in remote areas where no terrestrial communications exist. Disaster relief agencies could fly or otherwise transport the earth station in to the stricken area and have virtually instant and high-quality communications with the outside world.

10. HARBOURS AND TERRITORIAL WATERS

As INMARSAT provides near-global coverage, a ship can initiate and receive calls to and from virtually anywhere -- with one important exception. Some nations still prohibit the use of communications equipment in harbours and territorial waters. This situation grew out of the early days of spark transmitters, which could interfere with local transmitters onshore or emit sparks hazardous to fuel depots in ports, but modern technology has overcome these problems. Satellite communications equipment uses low power, will not interfere with other radio equipment and does not, of course, emit sparks.

Some countries prohibit any radio communications in harbours or territorial waters because of a fear that local networks would lose revenue. This is not necessarily true, however, because ships having access to good local communications will tend to use them, if for economic reasons alone. Nevertheless, in many parts of the world, local telecommunication facilities are just not available when required or, when available, are often operator-controlled, resulting in long delays. There may also be language difficulties which complicate local use. As a consequence of such delays, particularly in emergencies, the countries concerned may actually be harming their economies.

In November 1981, the INMARSAT Assembly urged "that all INMARSAT Parties take those actions necessary to make possible the use of ship earth stations within their harbour limits and territorial waters." INMARSAT has also had close co-operation with other international bodies, such as IMO, the International Chamber of Shipping and the ITU and has obtained their assistance in drawing this matter to their members' attention. The World Administrative Radio Conference for mobile services, held in March 1983, adopted a recommendation inviting States to consider permitting ship earth stations to operate within harbour limits and territorial waters. More than 20 INMARSAT member States now permit the use of satellite communications in harbours.

11. THE FUTURE

Although INMARSAT was created to serve maritime requirements, other possible applications were foreseen at the international conference which conceived the Organization. Some of the applications, the feasibility of which INMARSAT is exploring, relate to aeronautical communications and navigation via satellite.

12. AERONAUTICAL COMMUNICATIONS

The international conference which established INMARSAT recommended that "arrangements should be made to undertake at an early date the study, without prejudice to programmes in planning, of the institutional, financial, technical and operating consequences of the use by INMARSAT of multi-purpose satellites providing both a maritime mobile and an aeronautical mobile capability."

The notion of aircraft using satellite communications is not a new one. In 1968, ICAO established a panel of experts to deal with the Application of Space Techniques Relating to Aviation (ASTRA). Over the next four years, the panel studied the technical characteristics for an aeronautical satellite system. Following a recommendation of an Air Navigation Conference, held by ICAO in 1972, representatives from Canada, the United States and the European Space Agency set up the Aeronautical Satellite (Aerosat) program. Aerosat was intended to carry out an international program for research and development of an aeronautical satellite.

The experimental Aerosat satellite was to to determine the desired characteristics of an operational aeronautical satellite for mobile communications and position determination. The satellite was to be launched in 1979-80, but it never reached the launch pad. By the end of the decade, the aviation industry was in the financial doldrums, and airlines were reluctant to spend money on an expensive, dedicated satellite system. Funding for the program dried up.

Fortunately, however, the interest in aeronautical satellite communications did not evaporate. In fact, ICAO and the International Air Transport Association (IATA) had even participated in some of the early discussions which eventually led to the establishment of INMARSAT.

In late 1982, ICAO said it intended to draft technical specifications for a future satellite system that could serve international civil aviation's mobile communications needs. The service as envisaged by ICAO would be designed to improve air-ground communications and would make use of low-speed digital data transmission on the L-band frequencies (specifically, the aeronautical R band) already exclusively allocated for the aeronautical mobile service by the ITU.

In the months that followed, INMARSAT continued its intensive discussions with ICAO and IATA and others, which were aimed at defining the aviation community's requirements and exploring institutional arrangements wherein the INMARSAT system could be shared for aeronautical applications.

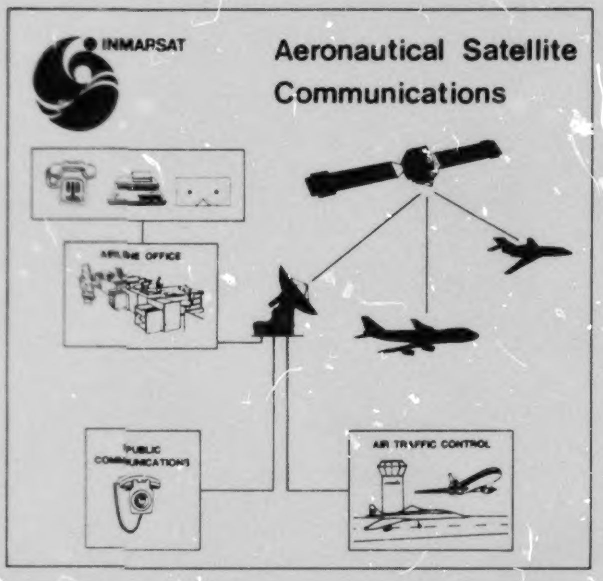
Prompted by ICAO's expression of interest in a satellite communications facility, INMARSAT's 14th Council session in May 1983 approved an amendment to a request for proposals (RFP), which was released in August 1983, for the second-generation

INMARSAT satellite system. The amendment meant that INMARSAT could provide an aeronautical capability with its new series of satellites, the first of which is scheduled for operation in late 1988. The amendment principally involved an extension of the upper end of the L-band bandwidth by about 1 MHz, and some changes to the C-band feeder link frequency bandwidths.

The fact that INMARSAT's second generation satellites will incorporate a small part of the aeronautical L-band doesn't mean INMARSAT is committed to providing an aeronautical service, nor that the aeronautical community is committed to using it. At this stage, it merely means that INMARSAT could, subject to detailed consultations with the aeronautical community.

Co-operation between the maritime and aeronautical communities in a shared satellite system is possible because their frequency allocations are adjacent and their technical requirements are similar.

Aircraft could use satellite communications for air-ground data links for air traffic control -- particularly across the north Atlantic, where airline traffic is the heaviest -- and for transmission of flight data and weather reports (Figure 6). A satellite data link would provide high quality, reliable and virtually instantaneous air-ground communications.



Satellite communications would represent a substantial improvement over present radio links. Existing links sometimes suffer from congestion, short range and atmospheric disturbance in many parts of the world, and there are areas where aircraft are effectively out of contact with air traffic services for parts of their flights.

Although a satellite communications terminal for civil aircraft has yet to be developed, INMARSAT is carrying out various studies which could facilitate its development. For example, INMARSAT awarded a $215,000 (U.S.) contract in September to Decca Electronics Limited of the UK, in conjunction with Miller Communications Systems of Canada. The contract is aimed at studying certain technical aspects of providing aeronautical communications via the INMARSAT system. The contract encompasses the following areas: propagation effects on aeronautical satellite links; antenna systems; modulation and coding methods; overall aircraft earth station (avionics) integration. As well, INMARSAT is studying development of a compact, lightweight and relatively inexpensive type of ship earth station. This terminal, known as Standard C, is initially intended to provide maritime users with medium-speed digital telex-type communications. Although a voice capability for such a satellite terminal is likely to be further down stream, INMARSAT is studying possible digital voice coding methods compatible with low data rates.

With development of a suitable terminal, aircraft could start using INMARSAT's existing satellite system on an experimental basis. It is more likely, however, that the aeronautical terminals would not start appearing in any substantial numbers until after 1988, when INMARSAT's second generation satellite system comes into operation.

13. FGMDSS

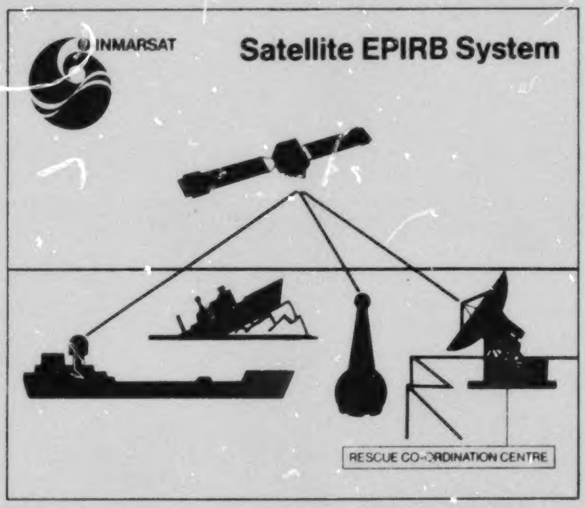
One of the major objectives of INMARSAT, as set out in the Convention of the Organization, is to provide improved facilities for distress and safety of life at sea communications. The immediacy and reliability of INMARSAT communications have led some countries to include the ship earth station as an alternative main transmitter for mandatory carriage on ships covered by the IMO Safety of Life at Sea (SOLAS) Convention. Many more countries are expected to follow suit as IMO prepares its new SOLAS requirements and its proposals for the Future Global Maritime Distress and Safety System (FGMDSS).

In its provisional description of the FGMDSS, in which INMARSAT is expected to play a major role, IMO states that it "intends to introduce by 1990 a comprehensive system to improve distress and safety communications and procedures which, in conjunction with a co-ordinated search and rescue infrastructure, will incorporate recent technical developments."

Although most countries have some sort of search and rescue facilities for aiding ships at sea, these facilities vary and their efforts are not co-ordinated on a global basis. One objective of the future system is to enable any properly equipped ship to achieve automatic distress alerting and be located with minimum delay. The system would also provide for the establishment of Rescue Co-ordination Centres where they do not exist and for a set of procedures for responding to distress alerts and carrying out rescue missions. Additionally the system will permit the dissemination of relevant navigational and weather information to ships.

An IMO report says "The system will use both satellite and terrestrial communications. Satellite communications will be provided by INMARSAT. A distress capability for alerting by satellite EPIRB will be provided by INMARSAT geostationary satellites as well as polar orbiting satellites. Terrestrial communications will use frequencies in the MF, HF and VHF bands. Terrestrial communications will no longer use Morse code radiotelegraphy but will employ digital selective calling, radiotelephony and narrow band direct printing." All equipment carried on ships will be designed for simple operation and will be largely automated.

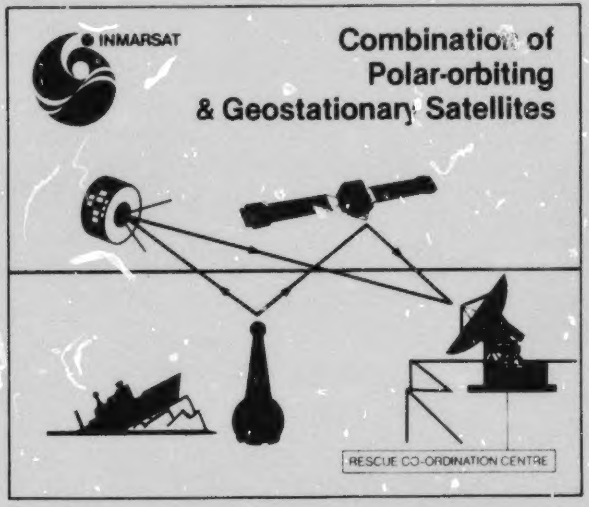
The satellite EPIRB (the acronym for Emergency Position-Indicating Radio Beacon) will be capable of sending a message via satellite giving the ship's ID number and its position co-ordinates (Figure 7). It could be carried on a ship or lifeboat, fitted in a buoy designed to float free and be activated should a ship sink. IMO is preparing the operational requirements, while the International Radio Consultative Committee (CCIR) is developing the technical provisions for a satellite EPIRB system. In 1982-83, a working group of the CCIR co-ordinated a series of trials using the INMARSAT system aimed at developing the technical specifications for a satellite EPIRB, operating at L-band, the same frequency bandwidth used by INMARSAT.



There is, of course, another search and rescue satellite system operating called SARSAT/COSPAS, which has been developed by Canada, the United States, France and the Soviet Union. The Soviet Union was the first to launch a satellite under this scheme, the Cosmos 1383, in June 1982. Two months after its launch, the satellite picked up signals transmitted from an aircraft which had crashed in northern British Columbia. By measuring the Doppler shift in the received signals, a rescue team was able to pinpoint the location of the aircraft. The speedy rescue which followed resulted in three lives being saved. Since then, two Cosmos satellites and an American NOAA satellite carrying similar payloads have been credited with saving more than 60 lives.

These satellites operate in a polar orbit 470 miles above the earth and detect signals in the 121.5 and 243 megahertz band, the international distress frequencies. Follow-on satellites will also operate in the 406 megahertz band which was recently allocated specifically for low power emergency beacons capable of being detected and located by satellites.

There are pros and cons to be said for satellite EPIRBs operating at 406 MHz or L-band. For its part, IMO has said that it would like to see a single international distress frequency for satellite emergency beacons. That would certainly be desirable from the perspective of the user whose equipment is likely to be cheaper than would be the case if it had to operate at two or more frequencies. It may well be that the optimum system would integrate both polar-orbiting and geostationary satellites in one scheme (Figure 8). Polar-orbiting satellites could carry additional payloads as well -- perhaps capabilities for navigation and thin-route communications, which would be especially valuable over the polar regions.



Funding for the SARSAT/COSPAS program will enable it to continue until the late 1980s, which will give the member countries time to consider what sort of institutional structure should be established for managing this program on an on-going basis. It has been suggested that one option would be to have INMARSAT procure and manage the system, probably because INMARSAT has the right sort of institutional structure. While this is an interesting possibility -- and INMARSAT is studying how a polar-orbiting system could be integrated with its geostationary system -- it does leave open the question of financing such a system.

INMARSAT may be willing to manage a search and rescue satellite program, providing it could be financed. Some one would have to pay for such a program. Right now, it is the taxpayers in the participating countries. Perhaps the burden should be shifted to the users — that is, the ships and aircraft required to carry emergency beacons — or perhaps it should stay with national administrations. This fundamental question is still to be resolved.

INMARSAT could also provide additional safety facilities, such as automatic ship reporting at regular intervals if position information is available to the ship terminal or a ship polling system whereby shore authorities could request ships to automatically indicate their positions. Position information could be obtained in a straightforward manner from the usual navigation devices carried on ocean-going vessels; the interface between this equipment and the shipborne satellite terminal could be achieved equally simply. However, in specifying such interface requirements, it would be desirable to include other data inputs from the ship which would be of use to the shipowner for effective management of the vessel. Information relating to ship's heading and speed, engine performance and crew payroll could be incorporated with position data as part of a standardized interface for transmission to authorized users on shore.

A related area of interest involves weather-reporting. The World Meteorological Organization (WMO) is exploring the use of maritime satellite communications to help improve the collection of maritime meteorological and oceanographic data, including weather reporting. WMO and INMARSAT are working on the possibility of providing a facility for the collection of data, which would be transmitted automatically from ship to shore.

14. SECOND-GENERATION SYSTEM

The satellites comprising INMARSAT's first-generation satellite system will near the end of their design lives in the late 1980s by which time the available capacity in the Atlantic Ocean region is expected to become saturated. In August 1983, INMARSAT issued a call for tenders on a new series of satellites which could cost several hundred million dollars. INMARSAT requires new satellites from 1988 to handle expected increases in the numbers of users of its system and to offer new services.

INMARSAT's Request for Proposals (RFP), which was sent to leading satellite suppliers around the world, says that bidders could offer spacecraft to be leased or purchased by INMARSAT. Depending on which option is selected, INMARSAT could be ordering as many as nine satellites, which would be launched over a three-year period starting in the second quarter of 1988.

The spacecraft must be compatible with more than one launcher of six listed in the RFP. Of the six, one (Ariane) is European, one (Proton) is Soviet and four (the Space Shuttle, Thor-Delta, Atlas-Centaur and Titan) are American.

INMARSAT's second-generation system is expected to have many more times the capacity of its existing system. The RFP calls for spacecraft with a minimum of 125 telephone channels, compared to the 40 channels provided by the Marecs satellite, the one with the greatest capacity in the current system.

Bidders are required to send their proposals to INMARSAT no later than 2 April 1984. The successful bidder or bidders will be chosen by the first quarter of 1985 and then, under the purchase option, will have 36 months to deliver the first in the new series of satellites. If it decides to purchase, rather than lease the satellites, INMARSAT would place contracts for the launch of the satellites.

As noted earlier in this paper, the RFP provides for the possibility that the second-generation system may be used for satellite communications to and from aircraft, as well as for new, smaller and more advanced ship earth stations to be introduced in the future. The number of users is expected to exceed 10,000 by the mid-1990s.

Viewed from the perspective of the 1990s, the current INMARSAT system will be seen as a humble beginning to a far-reaching change in maritime communications. While INMARSAT is interested in the economies of scale which can be achieved through satisfying requirements for other mobile satellite communications and in new services, it will remain firmly attached to its maritime roots, serving the needs of mariners in the most cost-effective way possible.

TABLE 1
INMARSAT MEMBER COUNTRIES AND SIGNATORIES
(as at 1 August 1983)

USA	Communications Satellite Corporation (Comsat)
USSR*	Morsviazsputnik
UK	British Telecom
Norway	Norwegian Telecommunications Administration
Japan	Kokusai Denshin Denwa Co., Ltd.
Italy	Ministero delle Poste e Telecomunicazioni
France	Direction Generale des Telecommunications
FRG	Bundesministerium fur das Post und Fernmeldewesen
Greece	Hellenic Telecommunications Organization (OTE)
Netherlands	Netherlands PTT Administration
Canada	Teleglobe Canada
Kuwait	Ministry of Communications
Spain	Compania Telefonica Nacional de Espana
Sweden	Swedish Telecommunications Administration
Australia	Overseas Telecommunications Commission (OTC)

Brazil	Empresa Brasileira de Telecomunicacoes S.A. (EMBRATEL)
Denmark	Post and Telegraph Administration
India	Overseas Communications Service
Poland	Office of Maritime Economy
Singapore	Telecommunication Authority of Singapore
China PR	Beijing Marine Communications and Navigation Company
Argentina	Empresa Nacional de Telecomunicaciones (ENTEL)
Belgium	Regie des Telegraphes et des Telephones
Finland	General Directorate of Postsand Telecommunicatons of Finland
New Zealand	Post Office Headquarters
Bulgaria	Shipping Corporation
Portugal	Companhia Portuguesa Radio Marconi
Algeria	Ministere des Postes et Telecommunications
Chile	Empresa Nacional de Telecomunicaciones S.A. (ENTEL-CHILE)
Egypt	Telecommunications Organization
Iraq	Republic of Iraq
Liberia	Republic of Liberia
Oman	Sultanate of Oman
Philippines	Philippine Communications Satellite Corporation (PHILCOMSAT)
Sri Lanka	Overseas Telecommunication Service
UAE	Ministry of Communications
Tunisia	Republic of Tunisia
Saudi Arabia	Ministry of Posts, Telegraphs and Telephones

* includes the initial investment share of Byelorussian and Ukranian SSRs.

Session II

Developments In [illegible] Technology

Optical Fiber Communication and Related Devices

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The present state-of-arts of the optical fiber communication and related devices are reviewed. The feasibility of the coherent optical transmissions is discussed. The problems and expected improvements are discussed on LD, LED and APD/PD. Emphases are made on targetting of the OEIC and development of the compact and high performance optical isolator.

1. Introduction

The communication network is the infrastructure of the modern society and no one will deny that the optical fiber communication (OFC), as well as the satellite communication, gives an innovative impact on the modern communication systems. Particularly, the global communication network cannot be talked without mentioning about both technologies.

In present talk, I will review the state-of-arts and future trends of the OFC as well as related devices. Althought the basic concept of the OFC was proposed very early (for example, in 1936 in Japan), its flowering had to be waited until several technological conditions were satisfied in 1970's. The progress of the OFC has been brought particularly, in the author's opinion, by (1) development of the low loss optical fiber, (2) realization of long life of the semiconductor laser, and (3) progress of the digital communication technology.

2. System construction of the OFC and related key devices

The OFC utilizes the light wave as the information carrier and optical portion of an OFC system consists of light sources as transmitters, photodetectors as receivers and optical fibers as transmission media, as shown in Fig. 1. The key devices/components in the OFC are, therefore, the semiconductor laser(LD) or the light-emitting diode(LED) as the light sources, the photodiode(PD) or the avalanche photodiode(APD) as the receivers and the optical fiber. Optical switching devices will be needed sometimes, when a network is constructed. Optical isolators are lacking in most of present OFC systems, although their necessity is emphasized by many peoples at many occasions. There are still several technical and also economical problems remained about optical isolators.

Signal processings in present OFC systems are made electronically in similar ways as in conventional coaxial transmission systems and micro wave links. A difference between the OFC system and the coaxial transmission system exists in equalizer design. By virtue of the wide band characteristics of the optical fiber, the equalizer disign is much simpler and sometimes equalizers can be eliminated in an OFC system. This is a hidden benefit of the OFC system.

Although all of modulation/demodulation techniques used in conventional electrical communication systems can be, in principle, applied to the OFC systems, the simple intensity modulation/demodulation is used in all of practical OFC systems. Other techniques like FM, PM and optical heterodyne are still in research level.

For convenience of considerations in later sections, I present here a classification of the OFC systems in terms of the type of the optical fiber, the characteristics of the light source and the modulation method, as shown in Table 1. This table also represents the historical development of the OFC.

3. Review of OFC systems for practical and commercial uses

I will present in this section a brief review of OFC systems which were already installed and will be installed for practical and commercial uses.

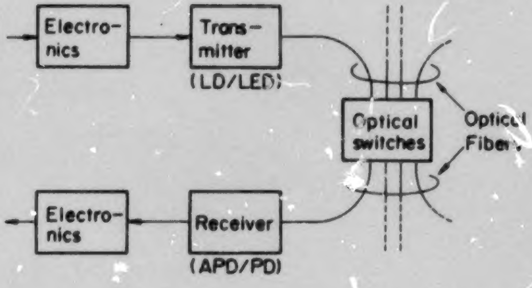

Fig. 1 System construction of the OFC.

Optical public communication systems have been developed and installed as the national level big projects.

In Japan, NTT made the first public OFC system field test during 1978 to 1979 in Tokyo. Based on the results of this and succeeding another field tests, NTT

	Fiber	Light Source	Modulation
1	MMF	0.85µm Planar LD	IM-Direct Mod.
2	MMF	0.85µm Transverse Mode Stabilized LD	IM-Direct Mod.
3	MMF	1.3µm Transverse Mode Stabilized LD	IM-Direct Mod.
4	SMF	1.3µm Buried Hetero Structure LD	IM-Direct Mod.
5	SMF	1.3/1.55µm Dynamic Single Mode LD	IM-Direct Mod.
6	SMF Polarization Preserving Fiber	1.3/1.55µm Dynamic Single Mode LD (Tunable ?)	ASK/FSK/PSK Optical Heterodyne

Table 1 Classification of the OFC systems.

started commercial service by 32 Mbit/s and 100 Mbit/s OFC systems for twelve different areas in 1981. NTT also is going to install 400 Mbit/s OFC system between Sapporo and Fukuoka till March of 1985. These OFC systems are to play significant roles in coming Information Network System(INS) promoted by NTT.

In U.S.A., AT&T is promoting installation of big OFC systems in both East coast and West coast.

British Telecom is also installing an OFC network in England.

Many OFC systems have been installed and started commercial services in regional levels. In Buenos Aires, Argentina, a big OFC network (34 Mbit/s and 140 Mbit/s) was installed by ENTEL and started commercial service in 1981. In Hong Kong, a big OFC network is now being installed.

Field trials of submarine OFC systems have been made in Japan, U.S.A. and U.K.. The 8th Trans Atlantic submarine cable, TAT-8, and the 3rd Trans Pacific submarine cable, TPC-3, are both expected to use optical cables and to start services in 1988.

Installations of optical fiber subscriber systems are in progress in Japan, BDR and France.

OFC systems in private uses, which include CATV networks, Local Area Networks, Data Links and Data Buses, are now expanding in U.S.A. and also in Japan.

4. Technological trend of the OFC system

The technological trend of the OFC system is characterized by the transmission distance-versus-bit rate relationship, as shown in Fig. 2. (Here, we consider PCM systems, because they are the most popular OFC systems).

Since the transmission distance for an optical fiber is limited by the propagation loss for low bit-rate regions and by the dispersion characteristics for high bit-rate regions, increases of transmission distances and bit-rates have been achieved by

i) optical fiber loss reduction by elimination of OH radicals,

ii) shift of light source wavelength toward lower fiber loss spectral region: 0.85µm ---→ 1.3µm ---→ 1.55µm,

iii) realization of the zero dispersion in single mode optical fibers,

iv) improvements in LDs from multi-longitudinal mode operation to single longitudinal mode (SLM) operation.

Figure 3 illustrates the state-of-arts of OFC systems in the transmission distance-versus-bit rate diagram from the view point of system installation.

Combination of an extremely low loss optical fiber at 1.55 um and an LD which exhibits single frequency operation even at high speed modulation (Dynamic Single Mode(DSM) laser after Suematsu) will give the longest transmission distance and the highest bit rate in the intensity modulation PCM (IM-PCM) system. Further improvements are expected by means of the optical heterodyne or more generally speaking the coherent optical transmission, which will be discussed in later section.

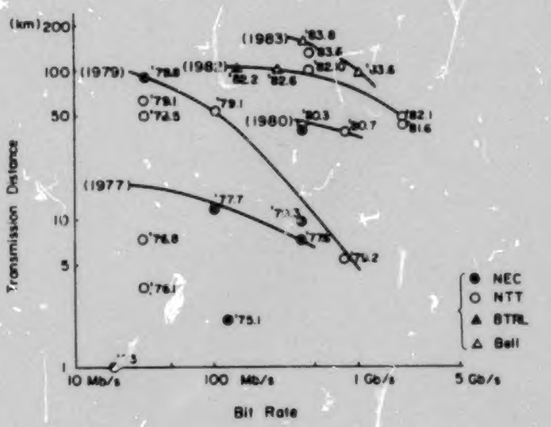

Fig. 2 Technological trend of the OFC system.

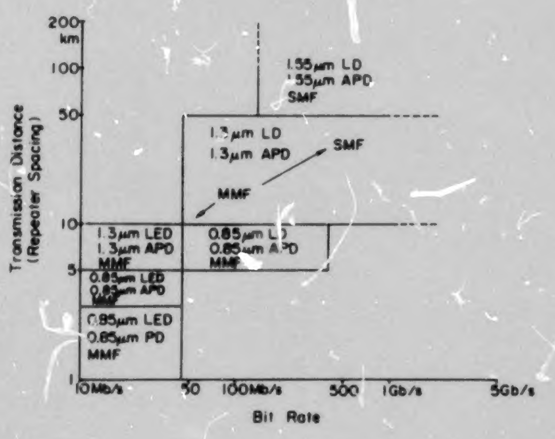

Fig. 3 State-of-arts of OFC systems.

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5. Analog OFC system

As I mentioned earlier, most of present OFC systems use the IM-PCM. This is of course along with the digitalization trend, but is also due to the light source characteristics. Requirements for the light sources are very severe in cases of analog systems, while they are rather loose in cases of digital systems. The present light sources, LDs and LEDs, are still far from the ideal signal generators for analog systems. On the other hand, however, needs for analog OFC systems still remain particularly in Japan. This is due to the low electronics cost of the analog systems compared with the digital systems. Sometimes, an already installed electrical analog communication system can be converted into an OFC system by replacing the transmitter and the receiver with the optical counterparts and by replacing the coaxial cable or the electromagnetic wave with the optical fiber.

The problems in analog OFC systems are:

(i) Degradation of the carrier to noise ratio (C/N) due to the fluctuation of the speckle pattern at fiber-to-fiber or fiber-to-detector interfaces. Recently, Kaede et al found that the fluctuation of the speckle pattern due to the frequency fluctuation of the LD at direct modulation results in increases of the harmonic distortions (1). This problem is proper to multimode fibers and can be avoided by using single mode fibers.

ii) Degradation of C/N due to the optical feedback to the LD. The essential solution for this problem would be the use of the isolator. On account of unavailability of isolators satisfying both performance and price requirements, a practical solution to this problem is to degrade the temporal coherence of the LD light by modulating the LD with a high frequency (several hundreds MHz) signal in addition to use of optics preventing reflections and reverse coupling (4). This technique can also be applied to solve the first problem in cases of multimode fibers. Kitaji et al has reported an improvement of C/N by using an LD with an external mirror (2).

iii) Nonlinearities of light output-to-current characteristics. Harmonic distortions of present LDs are very close to the theoretical values which are themselves insufficient to meet the requirements for the analog transmission of multiplexed VHF signals. It is very hard to predict whether the LD of extremely high linearity could be developed.

Use of an LED instead of an LD is another solution for both the first and the second problems.

I think the problems mentioned above can be solved eventually, but can the analog OFC systems survive untill that time against expanding of the digital OFC systems?

6. Coherent optical transmission

At the early stage of optical communication research, many peoples aimed to realize the optical heterodyne system, but several technological difficulties have turned people's eyes from the optical heterodyne to the IM-PCM system. Recently, interests on the optical heterodyne system or, in more general term, the coherent optical transmission have revived. This may be due to that the IM-PCM system has reached technological maturity.

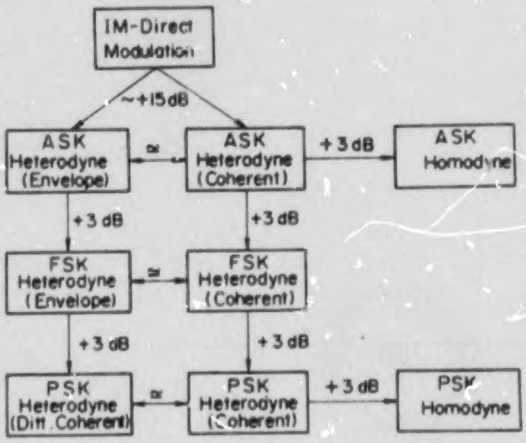
IM-Direct Modulation
~+15dB
ASK Heterodyne (Envelope)
≅
ASK Heterodyne (Coherent)
+3 dB
ASK Homodyne
+3 dB
+3 dB
FSK Heterodyne (Envelope)
≅
FSK Heterodyne (Coherent)
+3 dB
+3 dB
PSK Heterodyne (Diff. Coherent)
≅
PSK Heterodyne (Coherent)
+3 dB
PSK Homodyne

Fig. 4 Sensitivity improvements by means of the coherent optical transmission (ref. (5)).

Okoshi et al made an analysis on the coherent optical transmission and gave to what extent the sensitivities can be improved for different types of the coherent optical transmission (5), as shown in Fig. 4. Experiments on the coherent optical transmission have made by many peoples (6)(7)(8)(9), and have shown that the coherent optical transmission can certainly improve the minimum detection level by few~ 10 dB. It is, however, current consensus that there are many problems to be solved. Most of these problems are concerned with the LD:

i) Single frequency lasing even at high bit rate modulation, that is, DSM LD as mentioned earlier.

ii) The extreme stabilization of the lasing frequency against varing temperature and driving current,

iii) Frequency tuning and frequency tracking of the local oscillator LD.

iv) Elimination of the optical feedback, which causes instabilities of the LD.

v) Methods of frequency modulation and phase modulation of the LD.

7. LD

It must have been common sense for electrical communication engineers that the signal source has to satisfy the single frequency spectrum with very narrow spectral width and the extreme high frequency stability against temperature and power fluctuations.

The direct modulation of the oscillator would be, also, out of their common sense.

The LD is the very unique device as the signal source, because it exhibits multi-frequency spectrum, particularly at high speed modulation, its frequency shifts easily as temperature or driving current changes and it can be directly-modulated. The LD development history is history of efforts for making the LD closer to the ideal osillator.

Figure 5 illustrates the LD improvements process. Since Lang has elucidated that the transverse mode stabilization is necessary to improve the static and the dynamic characteristics of the LD (12), several tens of different transverse mode stabilization structures have been appeared. Requirements for reducing driving currents have brought different lateral current blocking structures to be combined with transverse mode stabilization structures.

Today, the buried heterostructure (BH) LD is accepted to be the goal of the transverse mode stabilized and lateral current blocked LD.

The BH LD exhibits excellent performances in static conditions: single transverse mode lasing, single frequency lasing, no kinks in I-L characteristics, low harmonic distortions and low driving current. For high frequency modulation (> few hundreds MHz), however, the BH LD still exhibits multi-frequency lasing. As the temperature varies, the logitudinal lasing mode jumps from a mode to another mode even in DC operation and this mode jump inevitably generates noises.

Requirements for further improvements of LD dynamic characteristics of the semiconductor laser have led three different types of LDs to appear. They are

a) distributed feedback (DFB) LD and distributed Bragg reflector (DBR) LD,
b) coupled cavity type LD which includes cleaved-coupled-cavity (C^3) LD (13) and short-coupled-cavity (SCC) LD (14), and
c) Interferometric type LD (15).

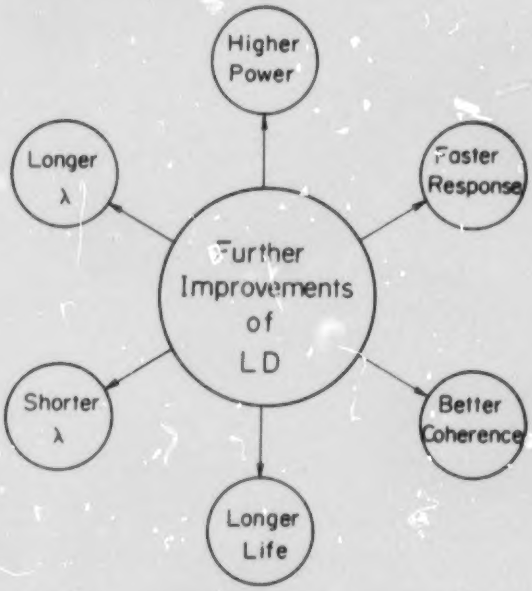
Higher Power
Longer λ
Faster Response
Further Improvements of LD
Shorter λ
Better Coherence
Longer Life

Fig. 6 Directions of further LD improvements.

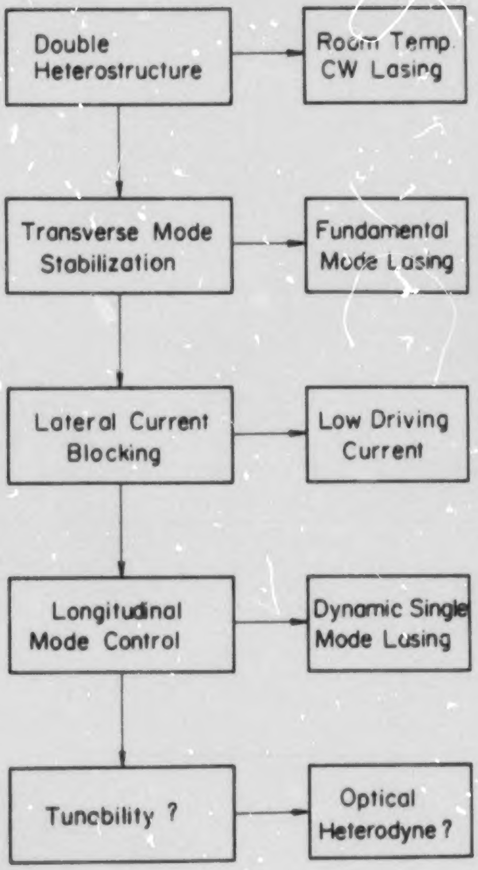
Double Heterostructure
Room Temp. CW Lasing
Transverse Mode Stabilization
Fundamental Mode Lasing
Lateral Current Blocking
Low Driving Current
Longitudinal Mode Control
Dynamic Single Mode Lasing
Tuncbility ?
Optical Heterodyne ?

Fig. 5 The process of LD improvements.

These three types of the semiconductor lasers all exhibit dynamic single mode characteristics as mentioned before. Reliabililty, stability and reproducibility problems remained for future. It is hard to predict what type of the LD can survive. The natural selection determine the winner.

Figure 6 illustrates directions of further improvements of the LD.

For the view point of OFC applications, reproducible and precise frequency control of the LD for WDM is much more required rather than extension of lasing wave lengths. This is, however, the manufacturing problem rather than the technical problem.

High power LDs are attractive for system designers, since the power increase results in increase of the repeater spacing and, therefore, cost reduction. It has been an established paradigm that the maximum lasing power of an AlGaAs LD is limited by the catastrophic mirror damage (COMD) and the catastrophic bulk damage (COBD)(16)(17)(18), while the limitation for the maximum lasing power for an InGaAsP LD has not beeen understood so well. The

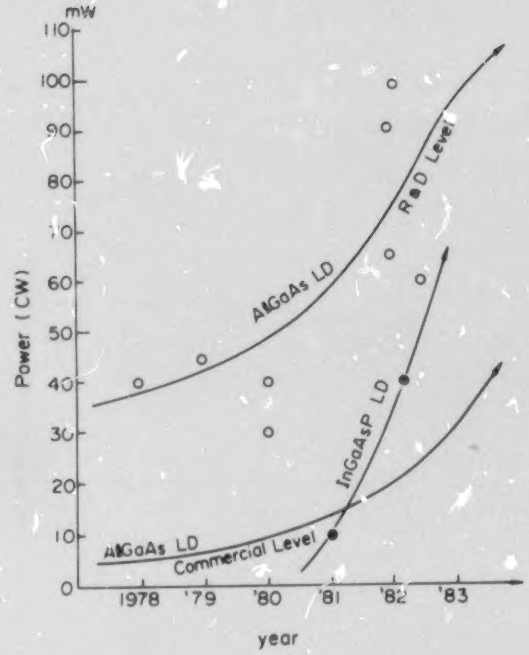

Fig. 7 Chronological trend of the maximum lasing power.

maximum lasing power of an InGaAsP BH LD seems to be limited by the electrical punch-through at the current blocking region, according to our experience, rather than the optical damage. Figure 7 shows a chronological trend of the maximum lasing power for both AlGaAs and InGaAsP LDs.

Noise reduction is not only the device problem but also the circuit and system problems. It should be achived combined efforts of the device, the circuit and the system engineers

The operating life times of the present LDs are of the order of 10^5 hours (19) and seem to be satisfactory for ground OFC systems, but higher reliabilities are required for them to be applied in submarine systems. The reliability should be expressed in terms of "Fits" instead of "Hours" for submarine systems, because a million hours or a ten millions hours of life times are obviously much longer than product life cycles and almost loose the physical meaning. Elucidation of the failure modes and determination of the acceleration coefficients for very long term operation are the problems to which we are now facing.

8. LED

The LED is much easier to handle compared with the LD. The LED does not need the isolator and shows no influence against the optical feedback. This is because the LED is not an oscillator. The life time of the LED is much longer than that of the LD and of the order of 10^9 hours (24). The drawbacks of the LED were that (1) low fiber-launched power and (2) low cut-off frequency. The coupling efficiency to a fiber can be improved by a few dB by using the monolithic lens structure as shown in Fig. 8 (25)(26). Modulations at 0.5～1.2 Gbit/s range have been realized by Suzuki et al (20) and Grothe et al (27), recently, although the output powers had to be sacrificed to some extent.

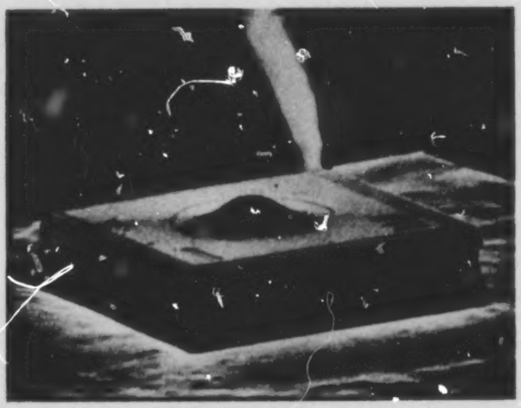

Fig. 8 A photograph of an LED with a monolithic lens.

Another drawback of the LED is the nonlinearity, which is more notable in InGaAsP LEDs than in AlGaAs LEDs. This nonlinearity arises from the nonradiative recombination at the double heterostructure interface (28), the carrier leakage (30), the Auger recombination process (29)(31) and the in-plane superluminescence (32). These processes are inherent to the LED and difficult to be removed. Electronic compensation for the nonlinearity is necessary, when an LED is used in an analog OFC system. Series connection of a diode with an LED in reverse polarity is the simplest way of electronic compensation of the nonlinearity. Straus reported more sophisticated compensation circuits (33).

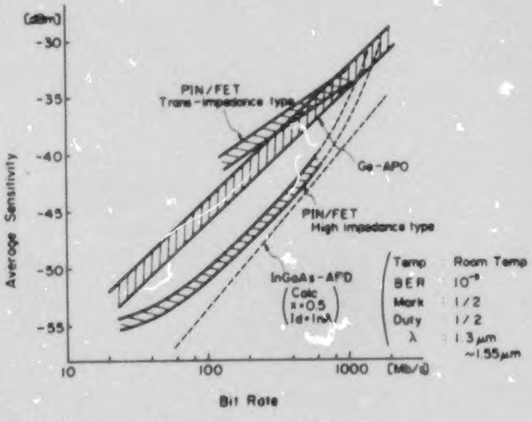

Fig. 9 Performance comparison of APD and PIN-FET for the long wavelength region.

9. APD/PD

There is no technological topic about Si-APD/PD, since they are matured devices.

Ge-APD, InGaAs-APD and InGaAs-PIN-FET are candidates for OFC systems in the long wavelength region. Figure 9 is a performance comparison of these three devices. Theoretically, the InGaAs-APD will provide the best performance, the InGaAs-PIN-FET the next and the Ge-APD the third.

The Ge-APD was only the commercially available photodetector for 1.3 μm region, up to very recent days. The reach-through type Ge-APD was also developed for 1.55 μm region (10)(34). The Ge-APD has drawbacks that the dark current is fairly high (say, 0.25 μA) and its temperature coefficient is also fairly high. In order to overcome these drawbacks, Mikawa et al have developed the small diameter Ge-APD (11). They could improve the minimum detectable power by 2.5 dB at 25 °C reducing the diameter from 100 μmϕ to 30 μmϕ to reduce the multiplied dark current from 50 nA to 5 nA.

The InGaAs-PIN-FET has become recently the commercially available photodetector for both 1.3 and 1.55 μm regions , particularly in Europe and U.S.A..

The InGaAs-APD has being expected for a long time to be the best photodetector for both 1.3 and 1.55 μm regions, but it seems to still have a problem. The problem is the slow response component induced by charge pile-up at InP/InGaAs heterointerface (35). This slow response component results in degradation of the minimum detectable power at high bit rates (say, few hundreds Mbit/s). This problem originates from the discontinuities of the conduction and the valance bands at InP/InGaAs interface. These discontinuities are inherent to the InP/InGaAs interface and amounts of the discontinuities are determined only by the composition of the materials at the both sides of the interface. It will be, therefore, very difficult to find to an essential solution to this problem. Insertion of a grading layer or a buffer layer between the InP and InGaAs layers is expected to improve this slow response but may be a temporizing solution. Use of the superlattice structure as proposed by Capasso et al (36) or use of other materials which have band-edge discontinuities smaller than InP/InGaAs may give better solutions.

10. Intergrated optics

After almost ten years have been spent just for talking about necessity, utility and promise of the integrated optics, concrete integrated optical devices have at last appeared before us in recent years. Combinations of PIN-FET, LD-FETs and LD-FETs-PD are integrated monolithically on AlGaAs and InGaAsP substrates (3)(21)(22)(23). Monolithic integration of electro-optical switch matrix on a $LiNbO_3$ substrate was also reported (37).

The integrated optics is classified into two categories, OEIC and OOIC. This classification is widely accepted in Japan. OEIC means "Opto-Electronic Integrated Circuit" and OOIC means "Opto-Optic Integrated Circuit". In other words, the OEIC is the monolithc integration of opto-electronic devices with electron devices and the OOIC is the monolithic integration of thin film waveguide devices.

It is current consensus that opto-electornic devices and electron devices in an OEIC take charge of signal transmisson and signal processing, respectively. Therefore, progress of the OEIC will be indebted to the III-V electron device technology to a large extent. We can expect that the OEIC will become the key component in the transmitter and the receiver of an OFC system in future. In my opinion, the bottle-neck for realizing this dream seems to be lacking of the targetting that what part of a system we are going to convert into an OEIC, rather than shortage of investment, although we always welcome larger investment.

Applications of the OOIC will be different from those of the OEIC. The optical switching system will be a candidate. An experiment of the optical time-division digital switching by using an integrated optical switch matrix was recently reported by Goto et al (38).

The OOIC formed on a semiconductor substrate, particularly III-V compound substrate, is obviously preferable to realize a monolithic integration of the OEIC and the OOIC on a single substrate. Recent reports on waveguides and waveguide devices based on III-V multiepitaxial layers seem to be along this line (39)(40).

11. Optical isolator

Use of an isolator is the common sense for microwave engineers to prevent the oscillator instabilities caused by reflected signals. Since an LD is an oscillator, it certainly needs an isolator. There have been several reports on optical isolators for both 0.85 μm and 1.3 μm regions.

It is generally very difficult to find transparent magnetic materials for 0.85 μm region, and rare earth-doped glasses will be the only selection. Because of its small Verdet constant, an 0.85 μm region optical isolator using Tb-doped paramagnetic glass was obliged to be of a faily large size (24x24.5x42 mm), although 36 dB (at 0.82 μm) of the isolation was satisfactory for most applications (41).

YIG is transparent and has a fairly large Verdet constant for 1.3 μm region. Optical isolators using a bulk and a thick film YIG crystal were reported (41)(42)(43). The device dimensions were reduced to 1/2 ~1/5 of the 0.85 μm device.

Unfortunately, present OFC systems still do not use optical isolators mentioned above. Further cost and size reductions and further isolation improvement are required. The cost-performance trade-off seems to force subsystem designers to look for a tricky conventional optical substitute.

12. Summary

The OFC has arrived at its flowering age and the OFC market is expanding. From technological view point, however, there are several problems which remain unsolved and seem to require breakthroughs. The optical coherent transmission, the DSM LD and the InGaAs-APD are examples. Once these problems are overcome, further great strides can be expected for the OFC.

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Growing Importance Of Software Development For Telecommunications Services

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1. Abstract

Several advantages of software control are discussed. The increase of the relative importance of software as compared to hardware is also discussed. We must recognize the growing importance of software development. Since project deadlines are becoming more important, project management technology should be improved. The turbulence theory is introduced as an idea to visualize project management.

2. GROWING EXPECTATION FOR SOFTWARE

Communication is one of the fundamental human needs. The exchange of communication with anybody, anytime, and anywhere using convenient and reliable methods is one of man's desires. Naturally, he also wants to lower costs as much as possible, to record when necessary, to refer to data, and to concurrently process information.

In addition to ordinary telephone services, non-telephone communications such as facsimile, video transmission, telex, and telemetering are already in use. Automobile, train public, automated maritime, radio paging, and portable telephone services are becoming common.

Satellite communication, which has such features as wide area, multiple access, disaster-immune services, and flexible, rapid line setting is also generally known as a new communication service.

As computers have been advanced, versatile devices for many applications have been developed. The recent progress of microcomputers have also created the potential for using these microcomputers as terminals.

The market for a highly reliable, highly efficient, high quality, and low cost communication service that serves a wide area and has versatile service functions in addition to allowing microcomputers as terminals has gradually been opened. To respond to this new market, the technology to provide flexible and strong control functions and systems which takes into account the future lowering of costs is required. One of the solutions is software.

Classical services where analog data communications are controlled by hardware are being changed to new services where analog information is controlled by software. These new services are being changed to even newer services where digital information is controlled by software.

The advantage of software control is flexibility. While this has been clear ever since computers were first applied to the field of communication, hardware was cheaper than software in the early days.

Presently, however, in addition to flexible control, software control is becoming cheaper than hardware control. In the future, software control will be the standard.

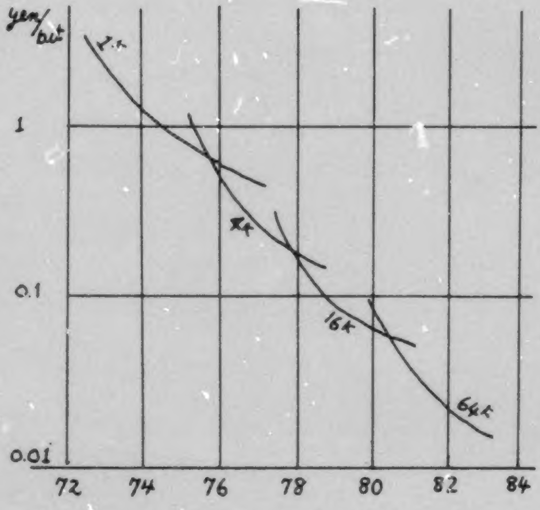

Fig. 2.1 Rapid decrease in the cost of memory

Since the cost of memory has shrunk to lower than one tenth of what it used to be in the past ten years and this trend may continue for the forseeable future, systems using microprocessors and memories where communications are controlled by software instead of wired logic are expected to become relatively inexpensive.

The impact of VLSI technology on software in the rapid lowering of memory cost and the development of microprocessors has established communication service control systems.

The software control of communication services also reduces the load on hardware and is a force in the standardization of hardware in the future. Standardization promises to reduce hardware and service costs.

Since the cost of software control has thus become lower, the flexibility of software control has become essential to respond to the sophisticated services of the market. The following are examples.

Constants for fixed abbreviated dialing and number groups, or information that varies for every conversation can easily be memorized if there are storage devices. Under software control, therefore, systems having storage devices, variable absent transfer, destination number resending, traffic measurement for each extension, and toll recording can be constructed economically.

When information of speech path states are stored in storage devices, high-grade control related to path connection alteration can be handled dynamically.

Since a change in the control system is equivalent to a change in the software, the requirement for changing the control system is mere replacement of the software.

By changing software, a switching system can be changed easily without hardware changes.

For the production of control facilities, software control also has many advantages over hardware control. Complicated control sequences are expensive when under hardware control, and is realized relatively easily under software control.

Another advantage of software control is the ease of using computer-related technology. Simulation technology, for example, enables the promotion of efficient computer use for the development of switching systems.

Since software control matches digital information well, it is advantageous when supercomputers are used for future store and forward switching or when computers and associated devices are connected as terminals.

As a result of more development in VLSI and optical communication, digital communication is expected to lower costs, increase efficiency, and high grade functions. Therefore, in addition to systems where analog information is controlled by software, we think that systems where digital information is controlled by software will be the mainstream in the future.

This future system is called the integrated services digital network (ISDN). To approach it, phased digitizations are scheduled. The design is supported by various digital transmission and control technologies.

In addition to these surface communication systems, satellite communication systems which have superior features such as a wide area, multiple access, and free line setting have already been in commercial use.

In the age of ISDN, communication systems will be grown up continuously, and new functions will be added simultaneously and globally from time to time while keeping local features. Thus ISDN cannot exist unless software is present.

We think that advances in computers and their associated devices will continue as a result of CA. VLSI advances will continue alongside them and software will thus become more advantageous.

Market requests will be more versatile, and cover a wider area. More complicated, higher qualities will be requested, and connections with digital devices will be promoted.

Considering the above, the expectation of software will be absolutely strong in the future.

3. INCREASE IN THE RELATIVE IMPORTANCE OF SOFTWARE

3.1 RISE IN THE DEVELOPMENT COST PROPORTION OF SOFTWARE

The VLSI revolution has made software control more advantageous than wired logic control. When software control was introduced, hardware standardization progressed. In addition to a reduction in the cost of hardware, standardization coming out of VLSI technology has also occurred. Thus, development and manufacturing costs of hardware have been reduced.

On the other hand, the unit price of development of software (i.e. cost per step) tends to gradually increase.

Several reasons may be given for this. Since software is extremely labor-intensive, it is affected by the personnel expenses that rise year by year. Productivity improvement has thus far remained behind the rise of personnel expenses.

As the scale of software grows, the man-hours for its development increases at a rate of approximately 1.5th power of the scale. Experience tells that as the scale becomes double, the man-hours becomes about 2.8 times. From this reason, the cost per step increases.

Software is usually developed in a great hurry. To hasten the date of delivery, intensive work is required. This requires more communication between developers than when a smaller number of developers develops during sufficient period, requiring excessive man-hours. Namely, the necessity to reduce the date of delivery causes the unit price of development to increase.

Communication software is of a large scale, continuously improved, and has functional additions over a long period of time. For additions to large-scale software bases, the unit price of additional software development is higher than that of new software. Because it is necessary to survey existing software before adding software and the man-hours required for the survey increase as modifications and additions are made, the documents required for modification and addition are generated on more complicated forms.

The development unit prices for newly developed and modified or additions to software has increased year by year in contrast to the hardware unit prices which continue to be reduced.

3.2 TENDENCY OF GROWING SOFTWARE SCALE

The costs of individual copies of software is negligible when compared with development costs.

If the market scale grows infinitely and the software in common use is fixed, the cost of software can be ignored and it is possible that the VLSI cost reductions will be transferred directly to the device.

However, because the market has been expanded with the promise of service versatility and media alteration, development of new and specialized software is required.

This situation is widely known in the computer field and is called the 90-10 rule. In other words, 90% of applications can be handled by 10% of the developed software, but 90% of the software must be developed for the remaininy 10%.

In analysis, conditions under which market requests become high grade and new software is always required are roughly divided into function, efficiency, and reliability (quality) requests.

The function request enlarges the work software a definite amount. Consequently, a larger memory and a longer process time are required at execution time. Therefore, as a whole the efficiency will be reduced unless some procedure is developed.

The efficiency, which decreases as functions are added, can be maintained to suitable levels by increasing the hardware performance and making part of software firmware. Another strategy is to upgrade the software structure.

In many cases, it is possible to maintain the efficiency at execution time while functions are expanded by using highly efficient software, but this causes the size of the software and its complexity to increases.

The quality of software lowers as the size of the software becomes large and its complexity increases. Development of software as a tool to guarantee the quality, and a tool to prevent human errors from being contained and to facilitate development are required. Actions for hardware and human errors must be incorporated in software. The scale of such error handling subroutines becomes larger with the increase in size and complexity.

In addition to the above the size and complexity of software grows with the associated efficiency and reliability maintenance. When the software is excessively large, new tools are required.

The scale of software development thus grows infinitely following market growth.

3.3 SECURITY

The control of software becomes as active as for hardware (wired logic) as software is stored in storage devices.

There is the possibility that the stored information such as programs, control commands and billing information may be accessed by someone who has not any access-right and yet wants to read them. He may add harmful functions into the programs.

No one can easily find that software to order specific communication interference, incorrect information generation, or charge information alteration has been added.

To revise software, write the new version of software into storage devices with no actions for the old version stored there.

Such a feature is useful when control of many switching systems is requested to change to new control simultaneously. However, the feature is in danger of that important information is destroyed before one knows by unauthorized access.

To change hardware, a physical change is necessary. The hardware must be approached and adequate energy and materials must be prepared. Usually light is required and noises are generated when modifying the hardware, causing difficulty in illegal modification.

For software, on the other hand, approaching the storage read/write access right can be done from long distance and it is possible to read or write to and from storage devices in the intervals of ordinary operations.

Approaching the storage read or write right is managed by software considerably. Passwords given to persons who have access rights are usually registered. If passwords are issued match the registered passwords, access is permitted. If not, access is rejected.

Since the number of digits for passwords in a network is small, infringing programs which automatically change values sequentially can easily detect legal password values, and can obtain the passkey. Such events have occurred.

At present, there is no way for nonspecific infringers to obtain access rights to software control storage devices.

If a system is created which does not physically distinguish the storage for communication information from that for software control, the system software control will be in danger of being modified by nonspecific infringers.

To protect the system from nonspecific infringers, the storage for speech information must be physically independent from the storage for software. Such independency is restricted for both function and efficiency.

For protection and management of the access right to storage for system control, several methods to strengthen facilities to identify persons who have the approach right correctly as well as simple short passwords can be used together. One of them is to use physical keys and locks.

Protection facilities may contain dynamic alteration of passwords.

Cryptography for speech and control information, consideration to handle especially important information, and to record the time when the information is changed, and to inform the adequate persons of the record, may also be required.

Thus to make sufficient protection of software control against infringements to obtain the control right.

Almost such countermeasures, regardless of whether hardware is contained or not, the software must be backed up, causing the scale of software to be developed to increase.

3.4 IMPORTANCE OF SOFTWARE DEVELOPMENT

Twenty years have passed since software was introduced in the communication service field. The relative importance of software has gradually increased, greatly increasing the importance of software development.

In computer history, the problems of software development were long studied by many persons. On well-known study was done by Boehm.

He said that the ratio of hardware and software is inverted around 1965 and the relative importance of software has increased since then as shown in the figure below. (Fig. 3.4.1)

The ratio of hardware and software development for electronic switching systems in Fujitsu is shown below. (Fig. 3.4.2) The ratio of software became higher than that of hardware in 1978. Compared with the Boehm diagram, they match completely with a time difference of 12 years.

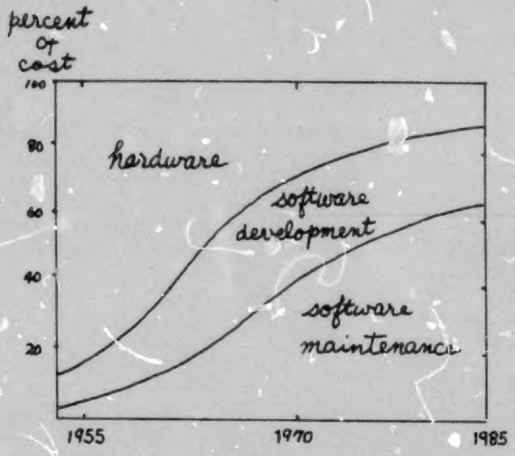

Fig. 3.4.1 Boehm's diagram

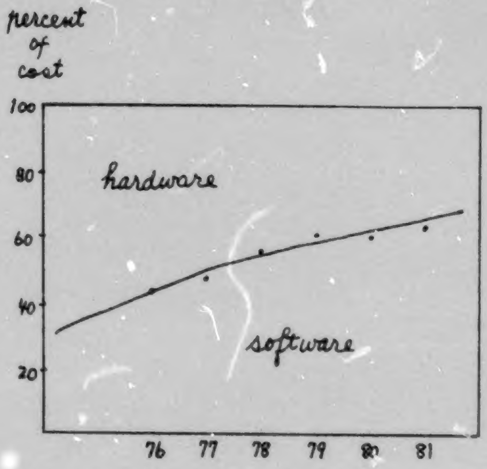

Fig. 3.4.2 Hardware/software cost ratio for electronic switching systems in Fujitsu

The relative importance of software is already higher than that of hardware. It is considered that this trend will probably increase.

With the spread and maturity of ISDN, the need for new functions, higher reliability, and security will increase. New communication services which are seemingly impossible at present will appear with the revolution of computer technology.

They may be translation telephone, electronic minutes, or electronic chess tournaments.

The relative importance of software is considered to increase to backup superior services.

If firmware is used for efficiency, the logical development and verification can be said to be software technology itself. Consequently, the relative importance of software is considered to increase as a whole.

Reducing the development time and guaranteeing the date of delivery is especially important. In this modern period of the lack of commitments, guaranteeing the date of delivery affects the worth of the software greatly. Software valued at $10 million completed within one year may be worth $1 million only after three years.

Based on the problems of software development accompanied with the increasing relative importance of software, the next section will introduce a new concept of project management.

4. TURBULENCE THEORY ON SOFTWARE DEVELOPMENT

4.1 LAMINAR FLOW THEORY

According to the DPMA report in 1982, 75% of planned software is not completed or has not delivered even if completed.

As a result of advances in software engineering, it is generally considered that the theory of software project management was established. However, some projects have failed and some projects are greatly retarded in their process schedules.

Why do software projects fall into failures This problem was studied, resulting in one theory:

(1) Generate requirements specifications after sufficiently checking user requests.
(2) Generate external specifications satisfying the requirements specifications and determine them after sufficient review.
(3) Based on the external specifications, design the software after sufficient review. In a topdown approach, design in detail, from the general to the more specialized.
(4) Do programming based on the design. Make program structures easily understandable.
(5) Do debugging correctly.
(6) Make inspections correctly.

By proceeding to next while checking the correctness of each phase, projects can progress without extra backing.

Although actual actions in each phase require various contrivances, projects can be considered to be managed correctly if the actions follow the instructions above.

Since the progress in each phase does not reverse, the flow of the process is like a laminar flow as in a river. Thus, the concept described here can be called the Laminar Flow Theory.

4.2 FLOW OF DEVELOPMENT

The characteristics of practical system software development for computers and communication are that the systems are large and complicated, and that they grow continuously to over ten years.

In the communication field, the systems are processed in real time for many, many terminals and are very complicated.

An important problem in practical systems is the delivery date. There are many milestones during development and the results at the break point are shipped. It is necessary to guarantee the accomplished functions and performance for each milestone.

Practical system developments, therefore, take a form of distributed development by many people and the speed of progress is not uniform. Since requests for the system are never given simultaneously and concretely, design must be started in a certain phase. New requests may be noticed after the initial design. Since design errors may appear after entering the programming level, it is difficult to enter programming after the design is finished completely.

Although it is natural that debugging is sometimes going back to programming, in system development it is sometimes necessary to change the original design or external specifications. Reverse work flow can take place here and there.

Practical systems are developed with the aim for not only doing work in good order but accomplishing as much work as possible in as short a term as possible. Therefore, to do work in the best order, work becomes a turbulent flow practically.

If the objects to be developed are definite and the development terms have a margin, projects must not be disrupted. In this case, sufficient attention can be paid to each development phase following the laminar flow theory.

If the flow is disrupted in such a favored environment, management must be incorrect.

However, if the maximum number of jobs must be accomplished in a short term, the disruption of the flow cannot be avoided by ordinary endeavors.

Software life cycle streams reverse locally here and there. The short back flow can be regarded as a laminar flow with a longer interval. Thus, if special efforts can guarantee high productivity, it can be said the flow can be handled smoothly.

However, since considerable reprogramming is necessary and it cannot be finished in two or three days, disruption in the flow cannot be ignored. The disruption phenomena are caused not by special faulty projects but by large-scale complicated software developments themselves. In other words, backflow cannot be said to be abnormal states for software developments for communication services. Backflow inevitably appears because the pressure to accomplish as much work as possible in a short term is high.

This disruption is an undesirable state which is unavoidably caused by strong pressure. Since pressure appears daily, disruptions can be caused daily. It is also necessary to control the extent of the disruption.

Since the importance of software developments for communication services has increased, compression of the development duration becomes the most important target, resulting in complication of development management -- complication caused by management permitting valid disruptions for reducing development durations rather than aiming for laminar flows and making efforts to change turbulent flows to laminar flows. It is necessary to manage for compressing development durations if complicated development management and turbulent flows are permitted.

4.3 CAUSES OF DISRUPTIONS

To smoothen software development, sufficient inspections must be made in each phase of projects so as not to back the results.

Even if the intention to make the flow of software development a laminar flow exists, work may be disrupted by strong pressure of short development durations. Since an extended development duration may rapidly reduce the value of software, a long term cannot be permitted.

If turbulent flows are unavoidable, theories to avoid uncontrollable turbulent flows (panic) and not to generate turbulent flows carelessly or meaninglessly must be developed. The theory for this interaction is called turbulence theory.

There are various degrees of turbulent flows. Some disruptions which cannot be perfect laminar flows but contain less work whose recovery require a short time can be regarded as laminar flow, rather than turbulent flow. Since finalization can be processed in an extremely short time, if the productivity of software developments is very high, flows which are regarded as turbulent flow phenomena are considered as laminar flow states. Therefore, the turbulent flow theory is considered to contain theories to improve productivity.

If productivity is improved, depending on its degree, the pressure to obtain results quickly is applied. Since turbulent flow phenomena are determined by the relative quantitative relationship between entire progress and finalization, it can be said that the phenomena are not dissolved by an improvement in productivity above.

The essence of turbulent flows is that finalization which cannot be ignored is generated. Assume that the probability curve of the finalization which must be resolved is as shown in the figure below.

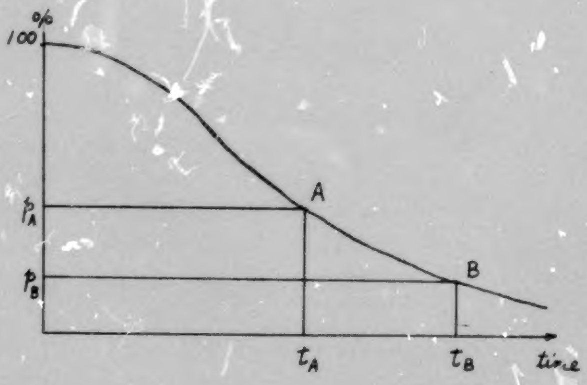

Fig. 4.3.1 Probability curve of the finalization

The figure shows that if sufficient time is permitted to handle a phase, e.g., design phase, the probability of the finalization which must be resolved in the next phase is gradually reduced.

For example, if t_A elapses the probability of finalization is p_A and if t_B elapses, the probability is p_B.

In the laminar flow theory, t is made sufficiently large, and p, probability of finalization, is requested to be sufficiently small. For actual work, the probability of finalization cannot be made sufficiently small because delivery restrictions exist. This is the essence of turbulent flow phenomena.

Strategies to control turbulent flow phenomena greatly depend on the finalization probability curve. In other words, a high probability of finalization is called low maturity of results in a phase, and low probability of that is called a high maturity.

If a probability curve of finalization is given, transition to the next phase can be determined when to what extent the maturity of results in one phase is enhanced. For example, to select point A or B, assume that the average finalization cost is b and the cost per hour in the phase is c. Briefly speaking, if

$$(p_A - p_B)b < (t_B - t_A)c \qquad (4.3.1)$$

it is more advantageous in costs when point A is selected.

When the equation (4.3.1) is not true, if the penalty of delaying the date of delivery is P per hour, time loss for finalization t is considered, and

$$(p_A - p_B)b + tP < (t_B - t_A)(c + P) \quad (4.3.2)$$

point A may be more advantageous.

If P is sufficiently large and

$$t \ll (t_B - t_A) \quad (4.3.3)$$

it may be advantageous as a whole if finalization (turbulent flow) exists.

4.4 CONSIDERATIONS ON DESIRABLE MATURITY CURVE

The laminar theory cannot be applied to provide optimal development strategies under delivery time pressure. If the probability curve of finalization in each phase in the software life cycle is known, optimal strategies can be generated to fulfill purposes. The curve is essentially equivalent to the maturity curve of results in each phase.

The problem of how probability curves of finalization or maturity curves are obtained has not been solved yet. However, the desirable shape for the curves can be given.

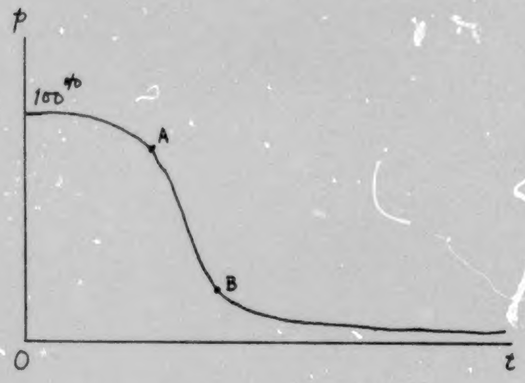

Fig. 4.4.1 Desirable probability curve of finalization

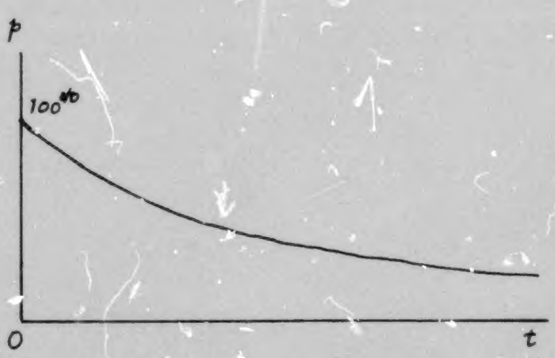

Fig. 4.4.2 Undesirable probability curve of finalization

Figure 4.4.1 shows a desirable curve and Fig. 4.4.2 shows an undesirable curve. In Fig. 4.4.1, the finalization probability rapidly lowers from point A and gradually lowers from point B. Therefore, it is easy to determine point B as the point to transfer to the next phase. On the other hand, in Fig. 4.4.2, such a decision is difficult. In addition to the ease of decision making, another remarkable aspect in Fig. 4.4.1 is that the probability of finalization occurrence is small early. In Fig. 4.4.2, it does not become small easily. From this reason, Fig. 4.4.1 is more desirable. The vertical coordinate axis p of the finalization curve means the finalization probability. By using the transformation expression, m = 100 - p, the coordinate is changed to m to draw the maturity curves of the results (Figs. 4.4.3 and 4.4.4).

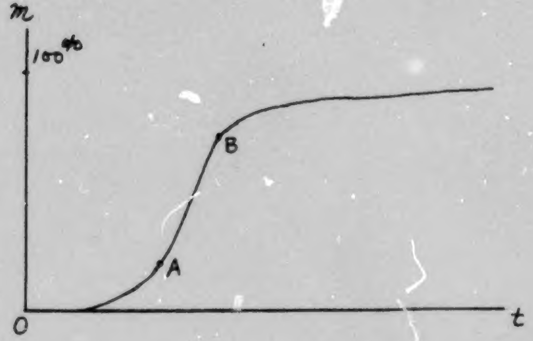

Fig. 4.4.3 Desirable maturity curve

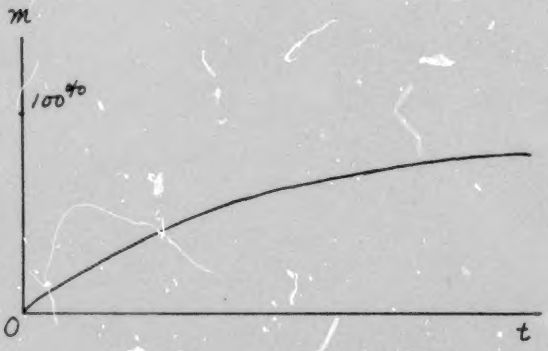

Fig. 4.4.4 Undesirable maturity curve

For the term, maturity, it is desirable that the maturity of the results in a phase rises rapidly and a value near 100% is obtained in a short term. Although methods to provide such tendencies are not offered yet in definite forms, several rules can be considered. They are described below.

The rules to rapidly enhance maturity of results in any phase of software development such as determination of specifications requirements, design of external specifications, or design of program structures, are to recognize the essence and to provide suitable representation.

Since it is almost impossible to recognize the essence of complicated and large-scale communications solely by personal survey and thinking, it is important that persons concerned offer for each other thinking materials in easily understandable forms by providing plain representation to recognize the essence. For this reason persons connected to software development are required to keep attitudes to sufficiently have a thorough knowledge of and intention to do the following:

1. Create common concepts, terminologies, and rules
2. Create common basic techniques
3. Create common tools
4. Create common documents
5. Hold accurate meetings and generating documents with a common value judgement and consciousness
6. Correctly recognize the software engineering basis such as topdown design, structured programming, and the use of a high level language and the date of delivery of projects in their charge

These have all been requested in the field of software development at all times, but their realization requires education and training composed mainly of OJT and continuous standardization.

To grasp the essence of problems, the following are useful if only temporary:

a. Grasp the essence of repetitive occurrence by promoting software metrix based on the thought and techniques of quality control.
b. Grasp the essence of new software by developing techniques to realize the idea of prototyping.

For representation of results, it is necessary to select representation as described below.

c. Understandable for development teams
d. Easily processed by computers
e. Suitable for problems of development

From this reason, the tools to generate documents in Japanese language, including Kanji, has increased in Japan. Programming languages handling abstract data types will be developed.

However, the problems are not solved by such degrees of answers. For representation technology, the optimization of graphics and voice for human interaction must be handled freely.

Since the enhancement of speedy software development serves the purpose of new generation computers rather than only the fields of communication service software, it can be expected that superior answers will be obtained along with future advancement of software engineering.

5. CONCLUSION

Problems to be solved to promote efficient software development are software international division of labor and software distribution acceleration, software development technology exchange and its education, software development environment arrangement, and arrangement of environment utilizing communication service technology.

These are all important and are problems which have early been handled internationally in computer industry.

Communications and computers were originally recognized to be different fields even in terms of software. This recognition was natural because the software itself differs although the techniques for software development are similar.

However, spread of network architecture and evolution in communication to ISDN seem to clarify recognition in which the difference between them is only the quantitative difference of communication and computing.

It must be clearly recognized that software development languages, development environment, and document representation systems are problems for both communications and computers. After discriminating proper technology and common technology, the two large fields, computers and communications, must be promoted together to make software development efficient and to use developed software effectively. This includes the software distribution system, education and development environment arrangement, and development technology.

Now that expectation for software has increased and the relative importance of software have become higher, software development is becoming one of fundamental industries in our information society. The request for development speed is strong. Therefore, true international cooperation is requested for obtaining more adequate development technology and more workable distribution.

Towards ISDN in New Zealand

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1. Abstract

Since the very beginning of electronic communications, New Zealand has been quick to apply the emerging technologies. Like many other Pacific nations, New Zealand's economy is critically dependent on international trade and telecommunications play a vital role in this. Also, like many other Pacific nations, the provision of high quality telecommunication services to many remote rural communities presents a special challenge. But new digital communications technology is rapidly providing solutions to these challenges. In less than five years a widespread digital communications infrastructure will be in place providing what is commonly known as the telephony integrated digital network (IDN). The next step, providing for integrated services and integrated access, will follow soon after. Thus, in New Zealand, the ISDN (Integrated Services Digital Network) is not just a futuristic concept, but a very real objective of a rapidly changing network.

2. INTRODUCTION

Since the very beginning of electronic communications, New Zealand has been quick to apply the emerging technologies. The first authenticated telephone call in New Zealand was made on February 2, 1878, only 2 years after Bell's invention. The first submarine telegraph cable between 2 countries was laid across the English channel in 1851. Twenty five years later in 1876 the first cable from New Zealand to the outside world was laid from Nelson to Sydney. In 1962 the first experimental communication satellite was launched. In 1971, less than a decade later, New Zealand's first earth station was commissioned at Warkworth

The major reason for the early utilisation of new technologies is New Zealand's geographic isolation from the rest of the world and its widely scattered population within the country. Some parts of the country can still only be reached by boat and our nearest neighbour, Australia, is some 2000 kilometres away (or 2 1/2 hours by plane). The country itself comprises three islands - two major ones, known as the North and South Islands and a minor one known as Stewart Island. The North Island has an area of 114 000 square kilometres and the South Island an area of 151 000 square kilometres. Together, the land area is slightly larger than the United Kingdom or about two thirds the size of Japan. But that is where the similarity ends. New Zealand has a population of only 3.3 million compared to the U.K.'s 57 million and Japan's 120 million.

This combination of low population and relatively large land area has created a special challenge in developing telecommunication services especially to remote rural communities. However, New Zealand is proud of the highly developed state of these services, which in terms of quality, are second to none.

Today, New Zealand, like an increasing number of other countries, has virtually achieved the primary telecommunications objective of the past century - universal telephone service at an affordable price. The network used to achieve this objective is essentially an analogue one. Physical cable pairs connect telephone instruments to local telephone exchanges. Electro-mechanical equipment at the local exchanges switch the calls to the required destinations, or in the case of toll calls, over more cable pairs to the central toll exchange. At the toll exchange, more electro-mechanical equipment is used to switch calls on to multiplexed analogue circuits to distant toll exchanges.

However, during the last decade, with increasing pressure being put on available physical plant and, more recently, with the growing demand for data communication services, digital systems are proving more cost effective. Although the trend towards digital communications is worldwide, the development paths being adopted differ from country to country. This paper describes how New Zealand, with its own special communication needs and geographic problems is entering the digital age and taking steps towards an Integrated Services Digital Network (ISDN).

3. COMMUNICATION NEEDS IN NEW ZEALAND

Why would New Zealand's communication needs be any different to that of other countries? Two major factors - geographic remoteness and low population density, but there are others. For example, New Zealand has a much varied topography. Much of the country is hilly and in the South Island there is an extensive mountain range, including Mt Cook at 3784 metres, one of the highest peaks in the Southern Hemisphere. While some of these hills have provided excellent sites for land mobile transmitters and microwave relay stations, in many situations they have created special problems in developing communication services. For example, in Wellington, our capital city with a population of 321 200, nine different transmitters are used to provide coverage for the country's two television channels. The use of a number of transmitters in the same area has been costly in terms of frequency spectrum. All 10 VHF television frequencies are used in various parts of the country to provide nationwide coverage of the two channels.

The long, narrow geography of New Zealand's two main islands has also created special problems in providing communication services. The country stretches over some 1800 kilometres and varies in width between 2 kilometres and 300 kilometres. Today, a backbone microwave link stretches from Kaitaia in the north to Invercargill in the south. This has involved the development of 92 repeater stations, many in isolated hilltop locations, accessible only by four wheel drive vehicles and, at some times of the year, only by helicopter.

The stretch of water separating New Zealand's two main islands - Cook Strait - provides a physical barrier in more than one way. Although the Strait is today well served by regular ferry and air services, the barrier remains. With the main population and industry base in the North Island and the main energy resources (hydro-electric and coal) in the South Island, the two Islands are heavily interdependent. Modern telecommunication services (using microwave radio to span the Strait) help to overcome this barrier.

One of New Zealand's greatest resources is its natural scenery and the tourism industry that this has generated. Telecommunications and tourism are linked in two important ways - through the environment and in the provision of services to the travel industry. Traditional methods for distributing telecommunication services - poles, wires, radio transmitters - all have a significant impact on the environment. In the development of these services in New Zealand, special attention has been given to environmental issues to ensure that the extent of any "visual pollution" is minimised. Widespread use is made of underground reticulation, both in urban and rural areas. Microwave and other radio antennas are carefully sited to avoid dominant intrusions on scenic skylines.

Although tourism is playing an increasingly important role in New Zealand our economy remains based on primary industries - wool, lamb, beef, milk products, timber, etc. Telecommunication services are vital in maintaining and developing these industries - both for the individual farmer and in expanding international markets. In New Zealand, basic telephone service is available to virtually all the rural community, no matter how isolated they may be. Despite the high cost of providing telephone service to remote areas, a Government commitment to provide affordable service to everyone has enabled this target to be met, although a small percentage still have manual service or share a party line. Nevertheless, steady progress is being made in upgrading these services to provide rural users with the same standard of service currently enjoyed by urban users. Multi-access radio systems are proving a more cost-effective solution than traditional cable and open wire plant. The provision of individual automatic telephone service to farmers has become especially important in New Zealand with the emergence of videotex information services. New Zealand farmers have been amongst the first to use microcomputers to assist with farm management; it is likely they will also be amongst the first to use videotex services.

International communications are critical not only to the farmer but to all New Zealand industries. Like many other Pacific nations, New Zealand's economy is critically dependent on international trade and telecommunications play a vital role in this. Although New Zealand is continuing to strengthen and develop local industries, the country remains dependent on the outside world for a wide range of manufactured products. Fast and efficient telecommunication services including telephone, telex and data, make possible international trade. New Zealand's international services are provided by both undersea cable and satellite - about half the traffic is carried by each. To meet the rapidly growing demand for international communications, both of these facilities are currently being extended - the ANZCAN cable linking Australia, New Zealand, Norfolk Island and Canada is being installed and a second earth station at Warkworth is scheduled to be commissioned early in 1984.

Telecommunications also plays an important role in allowing New Zealanders to pursue the lifestyle of their choice. Although New Zealanders are geographically mobile, they are able to maintain family contacts through the use of modern communication systems. Unlike many other countries, New Zealand has adopted a rating policy based on large "free calling" areas; revenue comes from fixed 2-monthly rentals and long distance or toll calls. This policy has encouraged widespread use of the telephone. With the introduction of STD (subscriber toll dialling) and ISD (international subscriber dialling) during recent years (now available to 58% of all subscribers), the physical barrier of distance is rapidly disappearing.

While New Zealand has some special communication needs and various obstacles to overcome in meeting these needs, it, at the same time, has some advantages compared to other countries. Unlike

North America and Europe, New Zealand lies within a single time zone. New Zealand has also benefitted from a stable and closely integrated communications infrastructure. Technical standards for telecommunication systems have been the responsibility of one organisation - the Post Office - and this has ensured the provision of services at world standards. New Zealand has also developed many of its communication services as a co-operative activity between Government agencies and private sector industries. The land mobile service is a good example. The fixed portion of this service - user base stations, landlines and transmitter/ receiver stations - is provided by the Post Office; the mobile portion is provided by private sector suppliers. A similar co-operative approach was used in introducing a nationwide telepaging service just over 12 months ago.

This mix of geographical milieu, market needs and industry structure underlines why New Zealand cannot rely on directly transferring overseas experience (this also applies to many other Pacific nations). Most new telecommunication developments emerge in large networks in densely populated areas. Equipment manufacturers tend to design and provide systems to satisfy these large markets and then to adapt "down" to meet the needs of smaller countries. It is often difficult to find an economic "New Zealand solution" to our communication needs due to the large module size of some equipment.

4. EVOLUTION OF DIGITAL TELECOMMUNICATIONS IN NEW ZEALAND

The major driving force for the introduction of digital communications in New Zealand has been an economic one. Despite a rapid growth in data communications during recent years, voice communications remains by far the most dominant requirement (and likely to remain so for at least the next two decades). The first digital application in the telephone network was pulse code modulation (PCM) equipment for providing inter-exchange junction links in the cities (during the early 1970s). Today, junction PCM equipment is widely used in both urban and rural networks.

SPC (Stored Program Control) digital telephone exchanges were introduced in 1982. All new exchanges will be digital. New Zealand has been able to leapfrog the SPC analogue stage of development by moving directly from electro-mechanical crossbar equipment in the 1970's to digital equipment in the 1980's. Digital PABXs were introduced in 1983. They are initially being used solely for voice communications, but their potential to integrate voice and data is recognised.

The first optical fibre cable was introduced into the public telecommunication network in 1983 (140Mbits/sec over a distance of 14 kilometres). Further applications are being planned. During 1983 a start was made in building a digital microwave system to provide backbone circuits for the trunk network. By 1986 it will stretch the length of the country. It will then be possible to provide a total end-to-end digital path between 75% of all major business centres. A packet switching service was also commissioned late 1983.

Through the use of these digital building blocks, the New Zealand network is steadily progressing towards an Integrated Digital Network (IDN) and eventually towards an Integrated Services Digital Network (ISDN).

5. TOWARDS ISDN

ISDN is an evolving concept. It has been defined by the CCITT (International Consultative Committee for Telegraph and Telephone) as:

> "a network evolved from the telephony IDN (Integrated Digital Network) that provides end-to-end digital connections to support a wide range of services, including voice and non-voice services to which users have access by a limited set of standard multi-purpose customer interfaces."

In New Zealand, development towards ISDN will involve three steps:

5.1 INTEGRATED DIGITAL NETWORK (IDN)

A network whose main function is the provision of 64 kbit/sec circuit-switched services. The infrastructure for this IDN will be in place in New Zealand within 5 years. The strategy being followed is to provide digital switching at trunk and key tandem exchanges with digital interconnecting circuits. This maximises accessibility to the IDN by the business community in New Zealand and provides a linked network of host exchanges for the digital redevelopment of the smaller local exchanges. This strategy maximises the rate of return on initial investment in digital equipment.

5.2 INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

Based upon IDN, two 'integration evolutions' will occur simultaneously - integrated services and integrated access. This evolution is widely referred to as the ISDN although the term Integrated Services User Access Network (ISUAN) could well be a more appropriate name for what will happen.

Narrowband (less than or equal to 64 kbit/s) services such as voice, data, text and image will become integrated as their terminal characteristics become better co-ordinated and unified, with some facility sharing. The most helpful initiatives in this area are coming from the CCITT.

User access to these services will also become integrated in the local loop; physically and in terms of network properties. Eventually, the three basic transport networks (telephone, circuit switched data and packet switching) will present a unified appearance to the user. Common channel signalling (CCS) will co-ordinate the user-to-network interactions. It may not be necessary, or even desirable, that the three basic transport networks merge into a single integrated physical structure, although it is possible that the CCS and the packet switching network could well merge. The timing for the formation of an ISDN to become evident in New Zealand could well be the mid 1990's. Many of the formative CCITT recommendations will be agreed in the 1984 Plenary and by the 1988 Plenary more detailed and definitive recommendations will almost certainly have emerged. Trial ISDN's are being installed now in some countries and there appears to be no reason why a mature second generation ISDN technology should not emerge in the early 1990's.

5.3 MULTI SERVICE NETWORK (MSN)

The ISDN will expand from its "narrowband" format to encompass wideband (greater than 64 kbit/s) transmission services (e.g., video conferencing) with communication and information processing facilities (e.g., language translation). This process could well accelerate due to the greater emphasis on digital signal processing within the terminal equipments. Two very significant recent developments are:

(a) The emergence of a proposed CCITT 32 kbit/s voice coding standard with 16 kbit/s research well advanced.

(b) The development of digital video, which will reduce the cost and complexity of the current generation analogue TV set and which can operate at rates of between 6 and 12 Mbit/s.

Implementation of this three step plan will proceed at a steady pace. The IDN development will be constrained only by available resources and economics. The ISDN development will proceed at a pace set by market demand for new services.

6. ISDN SERVICES

In most circumstances, the end user of a telecommunication network is not particularly concerned about the network structure nor how it is evolving. Most users have little interest in whether the system is a single integrated network or a number of separate networks, whether it is digital or analogue, or whether it uses satellite or optical fibre links. The user is primarily interested in the services offered and the performance of these services.

The services that can be supported by an ISDN have been well documented in CCITT Recommendations (1) and a number of other publications. A recent book by Dr Yasusada Kitahara from the Nippon Telegraph and Telephone Public Corporation in Japan describing the "Information Network System" is an excellent example (2).

In New Zealand, the first and major demand for integrated digital services will come from the commercial sector and most probably will be an extension of the integrated voice and data services already available on digital PABXs. Basic telephone service will remain a key component, but enhanced telephone services such as conference calling, call transfer, and voice messaging (store and forward) will no longer be confined to the PABX. Emerging text and image communication services such as teletex, videotex, facsimile and electronic messaging will also become widely available with ISDN. Local Area Networks are being established today to meet the demand for high speed data transfer and the interconnection of a wide variety of data processing equipment within user premises. The emerging IDN and eventually the ISDN will extend the reach of these networks both nationally and internationally.

Beyond the digital PABX, the demand for integrated digital services will extend to the smaller business and especially the retail area, where videotex terminals, credit card authorisation telephones and data entry terminals such as those used at supermarket checkouts or for stock replenishment will become commonplace. The final reach of the ISDN will be into residential dwellings, where the need for multiple and simultaneous telecommunication services, such as telemetry (alarms, meter reading), telephone, videotex, telecomputing and electronic messaging will continue to grow.

7. IMPLICATIONS FOR NEW ZEALAND

The development of ISDN in New Zealand will be influenced by many factors. Those of special importance include:

7.1 The demand for data/text/image services will be small and uncertain at each Local Exchange (LX) for much of the evolution period. Therefore, equipment module size will be a dominant factor in determining response time to, and cost of, service demands. The most economical approach will be to host the user access network at the Primary or Tandem exchange (PX/TX) and to regard the LX as a concentration point for all services. This allows simplification of the LX-PX (TX) common channel signalling facility on the "thin" routes typical of New Zealand and concentrates ISDN facilities to a cost effective scale of size.

7.2 User access at the lowest level of the network hierarchy is likely to be via data multiplexers; these could be used to concentrate CCS together with the user services being provided.

7.3 Without a local call charging capability in the existing telephone network, there are major difficulties in charging for non-voice traffic; ISDN will make possible a real time charge management system for emerging new services such as videotex.

7.4 The integration of telecommunication services is inherent in the concept of ISDN. In New Zealand, responsibility for the provision of all telecommunication services, including most customer premises equipment (telephone instruments, PABXs, data modems, etc.), is vested in one organisation, the Post Office. Unlike many other countries where there are a number of network providers and where different structures exist for different types of telecommunication service, the New Zealand telecommunications industry is well placed to move towards ISDN.

8. CONCLUSION

New Zealand is moving rapidly towards an ISDN. This is not a 20-year dream, but a realisable development. By the end of 1985, almost 25% of New Zealand telecommunication users will be connected to an SPC digital exchange. By 1986, end-to-end digital paths will be available in 75% of all major business centres.

Two factors will guarantee continued progress in New Zealand towards ISDN. The first of these is an insatiable demand for an ever increasing range of telecommunication services; the second is a close-knit and unified communications industry structure. The development of ISDN in New Zealand will not be complicated by the complex industry structures that exist in many other countries.

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Technological Development of Antennas for Satellite Communications

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Abstract

With the growth of satellite communications, congestions of geostationary orbit and frequency spectrum have been taken up as important problems. The antenna for satellite communications plays an important role in the efficienct use of these resources. This paper describes recent antenna technologies for both communications satellites and earth stations. These technologies include a shaped beam, a multiple beam, a scanning spot beam for satellites, and include a Cassegrain, an offset parabola, and an offset Cassegrain antennas for earth station.

1. INTRODUCTION

In satellite communications system, antennas are prepared for space and earth stations, and are used for transmitting and receiving radio waves between these stations. The antenna is one of the most important subsystems and affects the performance of the system. Antenna technology has been developed as well as satellite communications since the first commercial communications satellite was realized by INTELSAT as a means of global communications in 1965. Satellite communications are used not only for international communications, but also for domestic and regional communications. In the Pacific area, it has also become an important means of telecommunications, and its use will continue to expand. The subjects on satellite communications were discussed in the PTC '83.(1) The arrangement of the satellite communications system in the Pacific region was briefed in the 1982 PTC Manila Seminar as well.(2)

With the growth of satellite communications, many satellites were launched in geostationary orbit and are planned for launching in the near future. These satellites also require frequency spectrum. As the geostationary orbit and the frequency spectrum are limited, efficient use of these resources becomes an important problem. Antenna technology gives some effective solutions to solve this problem. This paper describes recent antenna technology for both communications satellites and earth stations.

2. APPLICATION OF ANTENNA TECHNOLOGY

As the geostationary orbit and the frequency spectrum are limited resources, these should be efficiently used. Regarding the geostationary orbit, it is important that the spacing of satellites in orbit should be made narrow by reducing interference with adjacent satellites and that the communication capacity per satellite should be increased. Regarding the frequency spectrum, it is important that a frequency band could be repeatedly used and that a higher frequency band could be made available. In order that these problems could be solved, the following antenna technology is effectively applied.

(1) A satellite antenna covering only a service area

By use of an antenna such as a shaped beam antenna and a multiple beam one, the same frequency band can be repeatedly utilized in a different area. As the antenna gain is higher, communication capacity can be made to increase.

(2) A satellite antenna of multiple narrow beams and scanning narrow beams

By use of multiple beams frequency reuse is possible in the same covered area. The narrow beam is related to a much higher gain of the antenna and to a higher capacity of communication. When the multiple beam and the scanning beam are applied in time division multiple access (TDMA), high operating efficiency of a satellite can be obtained.

(3) An earth station antenna of a narrow main beam and low sidelobes

The narrow main beam and low sidelobes reduce interference with adjacent satellite systems. Therefore, the satellite spacing in orbit can be made narrow. As the low sidelobes are able to reduce also interference with terrestrial communications system, they allow frequency reuse between space and terrestrial systems.

(4) A dual-polarized system

A frequency band can be doubly used if antennas which can radiate two signals in orthogonal polarization are adopted.

(5) A higher-frequency system

Many radio frequencies for fixed-satellite services are allocated. The frequency bands of 6/4GHz and 14/11GHz are mainly used. As the systems of these frequency bands increase, use of a higher frequency will be required. The satellite communications system in the 30/20GHz bands is practically used in the Japanese domestic satellite "SAKURA".

3. SATELLITE ANTENNA

3.1 CHARACTERISTICS OF A SATELLITE ANTENNA

A satellite antenna radiates and receives radio waves to/from many earth stations, and must reduce interference with other systems. The antenna should also satisfy environmental conditions similar to a satellite loaded with it. The characteristics required for a satellite antenna are as follows :

(1) Electrical characteristics
  (a) Beam covering a service area
  (b) High gain
  (c) Low sidelobes
  (d) Good cross-polarization discrimination

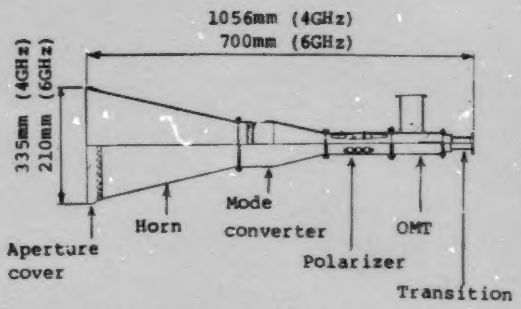


Fig. 1 Configuration of global beam antenna for INTELSAT-V.

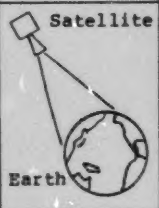
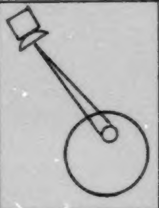
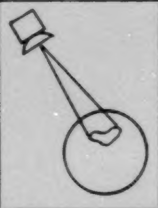
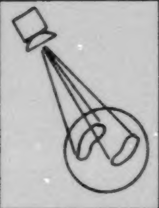
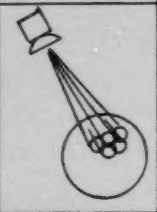
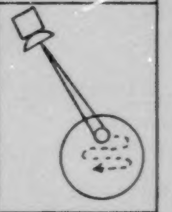
(2) Mechanical conditions
  (e) Light weight
  (f) Small volume fitting within a launch vehicle
  (g) Adaptation to stabilization subsystem
  (h) Adaptation to the environment of launch and space

Many types of antennas have been developed for satellites. They can be classified as shown in Table 1 in regard to the functions of antenna beams.

3.2 GLOBAL BEAM ANTENNA

A global beam antenna which covers the whole of the earth is employed in the INTELSAT satellite. The beam width required is 18 degrees and more. Good polarization characteristics are required because a dual polarization system is applied. Fig.1 shows the configuration of the INTELSAT-V global beam antennas in the 4 and 6GHz bands(3) In order to get a good

Table 1 Antennas for communications satellites

Antenna beam type	Global beam	Spot beam	Shaped beam	Multiple shaped beam	Multiple spot beam	Scanning spot beam
Beam configuration						
Antenna type	• Horn	• Offset parabola	• Shaped reflector • Offset parabola fed by horn array	• Offset parabola fed by horn array	• Offset parabola fed by horn array	• Offset parabola fed by phased array

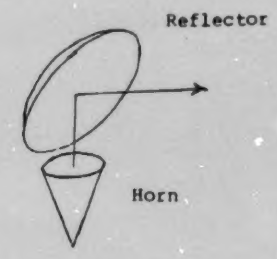
polarization discrimination, a flare-iris type dual-mode conical horn is adopted. The conical horn is made of multiple layers of carbon fiber reinforced plastic (CFRP) chosen for its light weight and small thermal expansion coefficient. This antenna is useful for a wide coverage area like the Pacific area with good polarization characteristics.

3.3 SHAPED BEAM ANTENNA

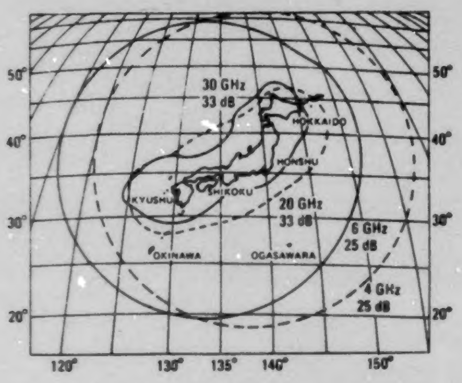
A shaped beam antenna which has a beam shape similar to the shape of the service area is very often employed in a communications satellite. By use of the shaped beam antenna the radiated energy from the satellite can be concentrated in the service area, and it is possible to obtain a gain higher than that of a usual circular beam antenna. Moreover, the radiated energy outside the service area can be reduced. Consequently, interferences with respect to another system can be avoided and the same frequency can be reused in another system. The following types of antennas are used as shaped beam ones :

(1) Modified-reflector antenna fed by a single horn

(2) Multiple-horn-feed reflector antenna



(a) Configuration.



(b) Radiation pattern.

Fig. 2. Shaped beam antenna using a shaped reflector.

The reflector of the modified-reflector type is designed so that the wave reflected by the reflector may go toward the directions of the service area. The features of this antenna are that multiple frequency bands can be used in common. This type of antenna is applied to a shaped-beam horn-reflector one of the Japanese domestic communications satellites.(4)(5) Frequency bands are the 4, 6, 20 and 30GHz ones. The configuration and the coverage pattern of this antenna are shown in Fig. 2. This antenna is constructed from carbon fiber reinforced plastic (CFRP) material in order to minimize the antenna weight and maintain dimensional stability over a wide temperature range.

A multiple-horn-feed reflector antenna is composed of a reflector and a horn array as shown in Fig. 3. A desired shaped beam can be obtained as resultant of multiple spot beams corresponding to the multiple horns. The shape of the beam can be changed by the arrangement of the horns. This type of antenna is adopted as the hemi/zone beam antenna of INTELSAT-V(6) and as the antennas of domestic satellites.

3.4 MULTIPLE SPOT BEAM ANTENNA

A multiple spot beam antenna has mutually-independent narrow beams corresponding to input/output ports and covers a service area with these beams. It is possible in the antenna to obtain a high gain by narrowing the beams and to use repeatedly the same frequency bands. The connections of the beams to transponders can be switched at will by use of a microwave switching matrix (MSM). An efficient satellite communications system can be realized by combining multiple beams and MSM with TDMA, as compared with a system in which connections of the beams are fixed. This antenna is useful for

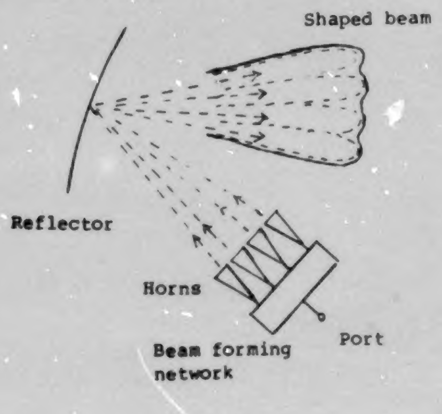


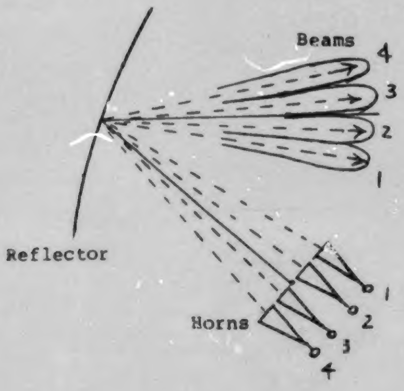
Fig.3. Shaped beam antenna using an array feed.

effective operations of large-capacity communications satellites. Several future satellite systems are planned and studied to use the antenna, and systems in the Pacific region are also studied.(7)

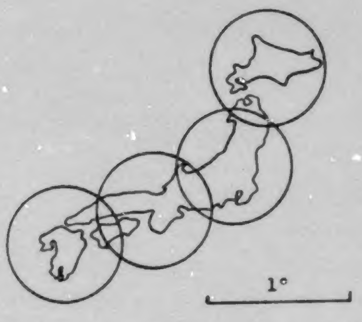
The principle of a multiple beam antenna is shown in Fig.4(a). This antenna is usually composed of an offset reflector, a feed array and a beam forming network. Fig.4(b) shows an example of the Japanese area covered by a four-beam antenna in the 20 and 30GHz bands.(8) The gain obtained is 39dB and more, and it is 6dB higher than that of the shaped beam. The increase of the gain is able to make an earth station antenna decrease by half in diameter.

3.5 SCANNING SPOT BEAM ANTENNA

In case of several earth stations located in a wide service area, a scanning spot beam system(9) in which TDMA is used is suitable. In the system, a narrow beam is scanned on each earth station by turns at high speed as shown in Fig.5, and is directed toward an earth station when the satellite accesses to this earth station. The system enables the raise of the antenna gain of the satellite and the adoption of small-sized earth station antenna, as compared with a system uniformly covering a service area. Moreover, the flexibility of the system is improved by use of multiple scanning spot beam. A phased array is applied in order to scan a beam. The beam of the phased array can be scanned by means of controlling phase shifters connected to the array elements. The scanning speed of a beam is of several nano seconds. If the range of scanning is relatively narrow, the scanning spot beam can be narrowed by combining a phased array and a reflector. That is, the narrow beam antenna of high gain can be obtained by a small-sized phased array. This scanning spot beam antenna is useful as one covering a wide and sparsely-populated area such as the Pacific region.

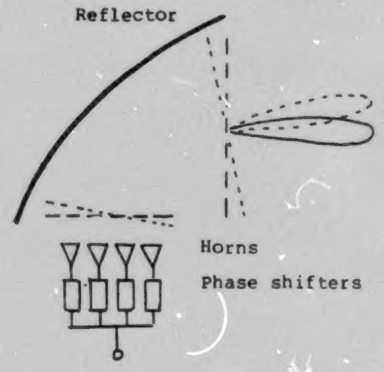


(a) Principle.

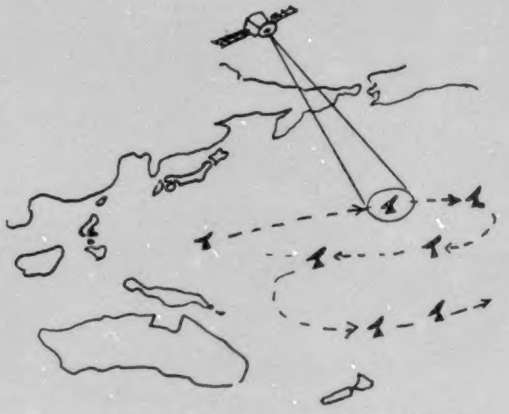


(b) Radiation pattern.

Fig. 4. Multibeam antenna.



(a) Principle of the scanning spot beam antenna.



(b) Beam scanning.

Fig. 5. Scanning spot beam antenna.

4. EARTH STATION ANTENNA

4.1 CHARACTERISTICS FOR EARTH STATION ANTENNA

The earth station antenna should be able to collect very dim RF energy from the satellite and pick-up the communication signal from the received energy which contains such unwanted signals as external noise and interference. It should also effectively radiate the RF energy from the high power amplifier to the satellite after covering its polarization to match with the satellite's polarization. Furthermore, it may be required to accomodate the dual polarization frequency-reuse system or the multi-beam frequency-reuse system.

Therefore, the earth station antenna requires the following characteristics :

(1) Electrical characteristics
  (a) High gain
  (b) Low effective noise temperature

Table 2 Antennas for earth stations

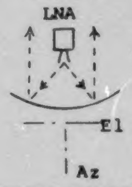
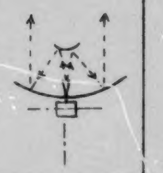
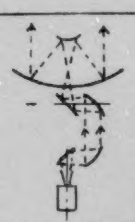
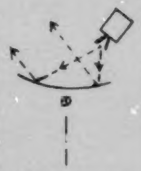
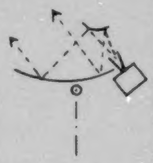
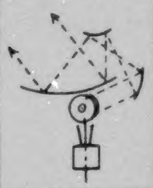
Antenna type	Axisymmetric type			Offset type		
	Parabolic antenna	Cassegrain antenna		Offset parabolic antenna	Offset Cassegrain antenna Offset Gregorian antenna	
		Horn feed	Beam wave-guide feed		Horn feed	Beam wave-guide feed
Schematic view						
Features	• Simple • Low efficiency • High noise temperature	• High efficiency • Low noise temperature • Fairly low sidelobes	• High efficiency • Low noise temperature • Feed & LNA stationary • Low sidelobes	• Simple • Low sidelobes • Poor efficiency	• High efficiency • Low noise temperature • Low sidelobes	• High efficiency • Low noise temperature • Low sidelobes • Feed & LNA stationary • Small windload

Table 3 Application of antennas for earth stations

Frequency (GHz)	Diameter (m)	Earth station		Parabolic	Cassegrain		Offset parabolic	Offset Cassegrain Offset Gregorian	
		Intelsat standard	Domestic & regional		Horn feed	Beam wave-guide feed		Horn feed	Beam wave-guide feed
6 / 4	29 - 32	A			○	○			
	8 - 13	B,D	*		○			○	
	3 - 8	D	*	○			○		
14 / 11	10 - 16	C	*		○	○			◌
	3 - 10	E1,E2,E3	*		○			○	
30 / 20	5 - 13		*		○	○			○
	1.5- 5		*		○			○	

- (c) Good radiation pattern
- (d) Good polarization discrimination
- (e) Wideband characteristics
- (f) High power transmission

(2) Mechanical characteristics
- (g) High surface accuracy
- (h) High pointing accuracy

Various kinds of antenna have been developed nowadays for earth stations. They can be classified as shown in Table 2 with respect to the configuration of the radiation systems. Features of the typical types of antennas are also presented in Table 2. According to these features, these types of antennas are applied for various earth stations as shown in Table 3.

4.2 CASSEGRAIN ANTENNA

A Cassegrain antenna has been widely used as an earth station antenna. It consists of two reflectors and a feed. Compared with the single reflector type, it achieves high gain, low noise temperature and good polarization discrimination, and allows a convenient rear location for a transmitter and a receiver. This antenna is usually about 100 wavelengths or more in diameter, and a front-feed parabolic antenna is employed below that. In order to get high performance, the following technologies are developed :

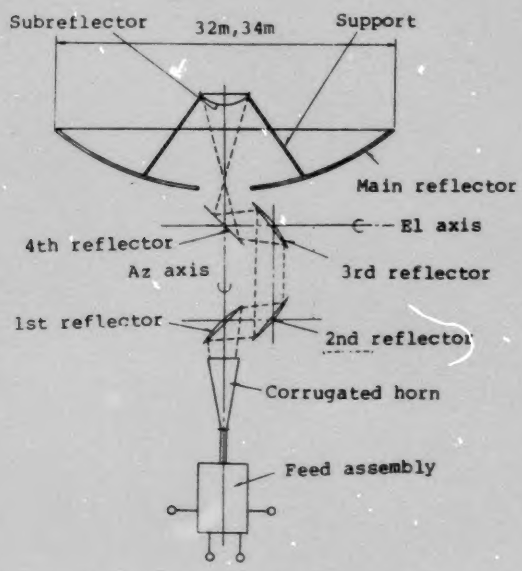


Fig. 6. A beam waveguide feed Cassegrain antenna antenna for INTELSAT Standard A earth stations.

(1) Shaped-refrector technique

The shaped-reflector technique achieves increased antenna efficiency and decreased noise temperature by designing both the main reflector and the subreflector to give uniform amplitude and phase distribution over the aperture.(10) By use of this technique, antenna efficiently is increased from the 60% of a conventional type to 80%.

(2) Corrugated conical horn

A corrugated conical horn has an inner wall with axially symmetric grooves, provides better axial symmetry of the beam and lower sidelobes than various other conical horns.(11) Because of its excellent radiation characteristic, the horn is used for a primary feed in the Cassegrain antenna and for a launcher in the following beam waveguide feed.

(3) Beam waveguide feed

A beam waveguide feed is composed of four reflectors and a corrugated horn, and is used for Cassegrain antennas. BY use of the feed, equipments connected to the antenna can be stationary on the ground, and low-loss transmission can be realized with broad band characteristics. This feed is widely employed in a Cassegrain antenna of large aperture such as an INTELSAT standard A earth station.(12)

(4) Improvement of subreflector support

Diffraction of subreflector supports is one of the factors raising the sidelobe level. The sidelobes can be suppressed by means of designing the shape of the supports. This design method is shown.(13)

The Cassegrain antenna for INTELSAT earth station is shown in Fig.6.(14)(15) The antenna has a four-reflector beam waveguide feed, a main reflector and a subreflector. The shaped reflector technique is applied to these reflectors. It has high efficiency, low noise temperature, and very low sidelobes. The accessibility is good because a feed and a low noise amplifier (LNA) can be installed in the room free from elevation and azimuth rotations.

The Cassegrain antenna has been developed in the field of earth stations, and it is applied for radio telescope. New technologies are adopted for the 45m radio telescope antenna(16) recently installed in the Nobeyama Radio Observatory, Japan, as shown in Fig.7. Some of these technologies may be also employed in the earth station antenna. The main features of the telescope are as follows :

(1) The antenna is operated by Gregorian

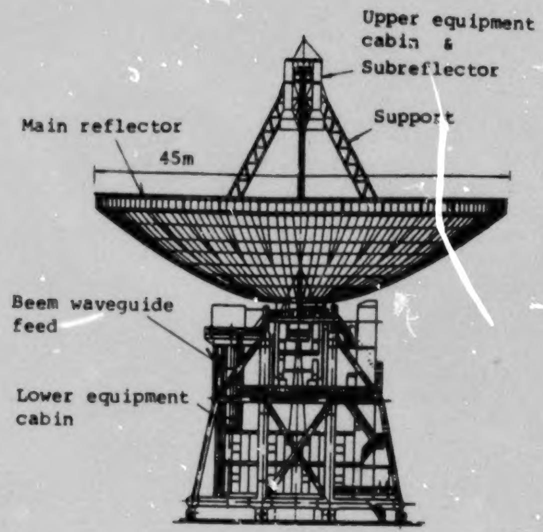


Fig. 7. 45-m antenna for radio telescope.

antenna with a beam waveguide feed for 10-86GHz, and works as a front-feed parabola antenna for 1-5GHz.

(2) Homologous design realizes a highly accurate large aperture paraboloid to make observations in millimeter-wave region possible.

(3) The CFRP (carbon-fiber reinforced plastic) is used as a skin of the sandwitch panels (accuracy 0.063mm rms) of the main reflector to reduce the deformation due to temperature effects.

(4) A computer is linked up to each panel's adjusting system which operates the 600-panel main reflector (surface accuracy 0.2mm rms).

4.3 OFFSET PARABOLA ANTENNA

The axisymmetric antennas have the drawback that the feed must be located in the center of the aperture. In this position it is in the path of the reflected waves from the most intensely illuminated area, and hence the feed and its supporting structures block out the aperture area, causing a loss in gain and an increase of the sidelobes. These defects are eliminated in the offset antennas. In these antennas the feed and its supporting structures are removed out of the aperture resulting in improvement in gain and in sidelobes characteristics.

The offset antenna is useful as a satellite antenna with an array feed, and also as a small-sized antenna for a small capacity earth station. Fig.8 shows a small capacity earth station antenna in the 4 and 6GHz bands.(17) The antenna has an elliptical aperture in order to get an elliptical beam. This elliptical beam is made narrow in the place of the geostationary orbit, and it avoids interference with the adjacent satellite. The elliptical beam also allows a simple satellite tracking system or a fixed beam system because the satellite moves further North and South than East and West. The gains are of 38dB and 42dB at 4GHz and 6GHz, respectively, and the sidelobes are very low.

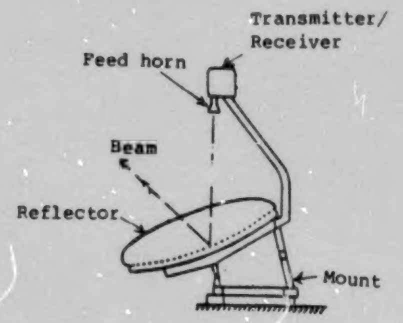


Fig. 8. Offset parabola antenna for small capacity earth station in the 6/4 GHz bands .

4.4 OFFSET DUAL-REFLECTOR ANTENNA

An offset dual-reflector antenna has a configuration similar to the offset parabola antenna. The subreflector and its supports are removed out of the aperture resulting in improvement in gain and in sidelobes characteristics. The antenna allows a convenient rear location for a feed. The offset dual-reflector antenna is classified into an offset Cassegrain antenna and an offset Gregorian antenna.(18) The former has a convex subreflector and the latter has a concave one. The offset Gregorian antenna can have good performance especially in relatively small one because it has some advantages about arrangement of its feed and reflectors.

This antenna produces the cross-polarization due to asymmetrical reflector shape. It is very important to eliminate this cross-polarization in order to apply the frequency reuse system of dual polarization. This cross-polarization can be eliminated by cancelling the cross-polarization of the main reflector and that of the subreflector.(19) The design method of the asymmetrical shaped reflectors is different from that of the symmetrical shaped reflectors. Several approximate synthesis methods have already been developed.(20)

The offset dual-reflector antenna can be applied to the antenna of several tens and more of wavelengths in diameter. A high efficiency elliptical beam offset Cassegrain antenna is studied in the 20GHz and 30GHz bands for small earth stations.(21) In this antenna, shaped reflectors of an elliptical aperture are adopted. The elliptical beam has the features similar to that of the offset parabola antenna. The antenna efficiency obtained is 81% in the 20GHz band. The gains are 56dB and 59dB at 20GHz and 30GHz. The sidelobes are very low.

Fig.9 shows a large aperture offset Cassegrain antenna in the 20GHz and 30GHz bands for a domestic satellite communcation.(22) As this antenna is installed on the rooftop of a telephone office in an urban area, it is required that the sidelobes should be very low and that the wind load should also be very low. These requirements are satisfied by use of a shaped-reflector offset Cassegrain antenna fed by a beam waveguide. The effective aperture is 11.5m in diameter. Aperture efficiencies are 76% and 68% in the 20GHz and 30GHz bands, respectively, and the sidelobe characteristics are excellent.

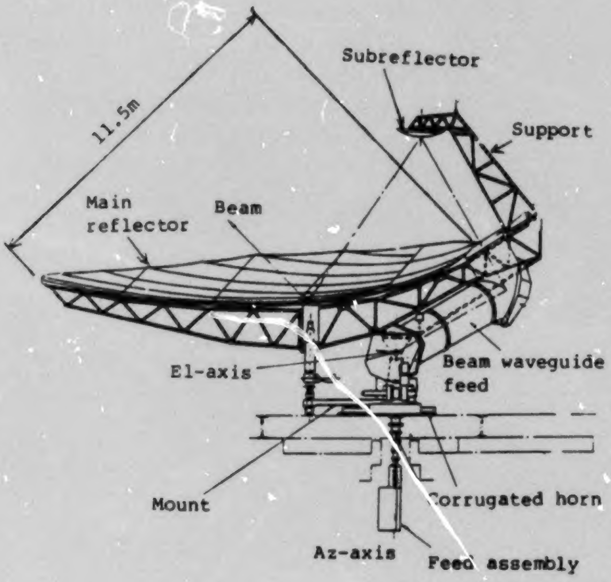


Fig. 9. Large aperture offset Cassegrain antenna in the 30/20 GHz bands

5. CONCLUSION

In satellite communications, the antenna technologies are important to solve the congestions of stationary orbit and frequency spectrum. The satellite antenna should have a beam covering only a service area such as a shaped beam, multiple beam and scanning spot beam. In the large-capacity satellite, the multiple beam antenna is useful. The scanning spot beam is useful for a wide and sparsely-populated area. Concerning the earth station antenna, the offset technique is important. It results in low sidelobe characteristics even in the small-sized antenna.

Moreover, the elliptic beam of the small-sized antenna is able to reduce interference with the adjacent satellites. The CFRP (carbon fiber reinforced plastic) material is useful for the millimeter-wave antenna in order to reduce the deformation due to temperature effects.

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Session 2

Telecommunication
and Information Policy
[illegible]

ATS-1: Social Service Satellite Networks in the Pacific

James Lange, Ray Casey, Bennit Dunqua, Colin Dunnett,
Gerald Knezek, John Flanigan, Elsa Flavel, Ed Houlton,
Kevin Livingston, Steven Seumahu, Peter Scannell and Peter Spooner

The Pacific island nations are the smallest and most isolated in the world. NASA's ATS-1 satellite has provided them with educational and social service networking for a decade, and is now expected to last another 10 years. This study outlines (1) the current status of ATS-1 voice and data networks, (2) the projected future of the satellite, and (3) barriers to serving the telecommunication needs which the use of ATS-1 has highlighted but cannot meet. An Appendix gives a detailed description of each of the five networks that operate on ATS-1.

In 1966, NASA launched its first geosynchronous Applications of Technology Satellite (ATS-1). In 1971, ATS-1 time was granted to the Pan-Pacific Education and Communication Experiment via Satellite (PEACESAT), an experimental network designed as an audio-conferencing system which would allow citizens of Pacific islands to talk with other Pacific islanders who shared similar interests. (Bystrom & Yuen, 1971) Since its inception, PEACESAT has mounted regular conferences on a wide range of subjects, putting together groups of Boy Scouts, Girl Guides, vulcanologists, primary school classes, physicians, church groups, college deans, farmers, and family planning specialists, to name just a few.

Since then, ATS-1 has been used for medical training and referrals in Alaska (Parker & Fowkes, 1974), to support tele-teaching to thousands of students among the nine member nations of the University of the South Pacific (Bensted, Northcott & McMechan, 1975; USP Extension Services, 1981), for government, educational and social service administrative traffic in Micronesia (Department of the Interior, and to communicate with research vessels at sea (Eden & Brown, 1976). In 1981, several Australian stations inaugurated a fifth ATS-1 network for experimentation with satellite tele-conferencing, in preparation for the Australian Domestic satellite due to be launched in 1985. (Kangaroo Net Bulletin, 1982) ATS-1 users have successfully experimented with voice, data, facsimile and slow-scan TV. (Seumahu, 1979)

Despite these successes, the ATS-1 satellite has been criticized as an "elitist" medium (Davey, 1983), which is under-utilized (Boker, 1982), by mostly caucasian "outsiders" (Plante, 1980). Until recently, these criticisms were thought to be academic, since the satellite was consuming its station-keeping fuel so rapidly that is was expected to go out of service by the end of 1983. However, NASA moved ATS-1 to a new orbit (roughly 164 degrees east longitude), and now expects the satellite to hold its position until at least 1993. The new orbit puts the satellite outside the reach of the United States mainland, while bringing it into line-of-sight for all of Australia and much of Pacific Asia. This new lease on life as a peculiarly Pacific resource has stimulated new interest in the satellite.

ATS-1 VOICE TRAFFIC

ATS-1 is a geosynchrous satellite using VHF (149/135 megaherz) on either side of the 2-meter amateur radio band. It has a band width of 100 kiloherz, but the class C transponder makes division of this capacity into separate channels difficult. If incoming signals are more than 3db apart, the stronger signal "wins" and all of the satellite power is devoted to its retransmission. In practice, the satellite is used as a single voice channel in a simplex (push-to-talk) FM mode. The satellite is currently located at approximately 164 degrees east longitude, giving it a footprint which extends from just off the US coast in the west, to about Bangkok in the east. Fully operational earth stations can be constructed for under $2000, using easy-to-maintain, off-the-shelf amateur radio equipment. A crossed-Yagi antenna with a 100-watt linear amplifier and a standard transceiver will access the transponder. Since no encoding is used, any good receiver tuned to 135.6mHz can pick up the ATS-1 traffic.

Some 50 ATS-1 terminals, providing access to hundreds of users spanning 7 time zones, more-or-less fill an active day from 1800 to 0800 Greenwich Mean Time. They are organized into five major networks which control large blocks of time each week: Kangaroo Net (26 Australian terminals, 22.5 hours), Micronet (8 Micronesian Terminals, 19.5 hours), Ocean Net (Hawaiian Institute of Geophysics and research vessels at sea, 12 hours), PEACESAT (22 terminals Pacific wide, 30 hours), and USPNET (9 regional centres of the University of the South Pacific, 20 hours). Each of these networks is described in some detail in the appendix to this paper.

Table #1 presents the results of a content analysis for the month of June 1983 (Lange, 1984) shows that ATS-1 scheduling efficiency (the ratio of available time to time actually used) is 51.4%, with individual networks running from a low of 23.9% for Ocean Net to a high of 72.5% (PEACESAT). Administrative efficiency, or "throughput", (the proportion of time used for content, as opposed to administrative functions) was 32.6%, with a low of 12.5% for Ocean Net and a high of 46% for the University of the South Pacific Network. Error rate is difficult or impossible to measure on voice networks, since oral communication is a highly redundant and ambiguous code. However, operators report signals as less than "loud and clear" 40.5% of the transmission time, a severe limitation on the potential of the satellite.

Within a given network, measures of design efficiency can be computed to test how well the network meets its own stated objectives. Most ATS-1 networks are intended to function in a multi-nodal teleconferencing mode rather than a point-to-point mode that would compete with common carriers. They are also designed to serve participants, rather than terminal operators, and to involve Pacific islandsers, rather than caucasians. (The Kangaroo Network, linking Australian terminals, naturally does not share the preference for islanders over caucasians.)

When the design efficiency percentages are multiplied by throughput, the resultant success index (SI) ratio concatenates the system failure, since it falsely assumes exclusivity of categories (for example, some non-participant staff are islanders) and ignores some systemic amelioration (for example, the proportion of participants is higher in content traffic than in administrative traffic). However, in analysing communications networks it is always preferable to under-estimate, rather than over-estimate, one's own success. Thus, the SI index can be used to compare network effectiveness, even though it cannot be interpreted as the percentage of effective network use.

Table #1: ATS-1 Network Efficiency

	% of Micronet Time	% of Kangaroo Time	% of USP Net Time	% of Peacesat Time	% of Total Time
Hours used	56.1	57.5	62.9	72.5	51.4
Used for Content	77.6	50.0	73.2	58.1	63.4
Throughput	43.4	28.8	46.0	42.1	32.6
x Teleconference	80.0	85.2	87.7	73.2	73.1
x Participants	53.1	69.6	52.7	50.4	50.1
x Islanders	38.8	N/A	53.6	43.4	39.0
Success Index (SI)	.07	.17	.11	.07	.05

The PEACESAT network uses 72.5% of its time, which indicates that a scheduling efficiency of 75% is a reasonable goal for an ATS-1 network. Although administrative efficiency in any HF simplex system is limited by required time for scheduling, polling, and copy checks, and although ATS-1 networks are run by low paid, public service operators who require considerable interpersonal interaction to maintain their sense of morale and their commitment to service, the Micronesia network (77.6% content) indicates that a mix of 80% content to 20% administration is a reachable goal for ATS-1 networks. This sets 60% as the target throughput, which is not bad for simplex systems. (See Abramson, 1977)

For design efficiency, the USP net (87.7%) indicates that a goal of 90% multi-node conferencing, as opposed to point-to-point traffic, is reachable. Similarly, the Kangaroo network, with 69.6% participants and only 30.4% operator traffic, indicates that 75% participant traffic is a not unreasonable target. No ATS-1 network does very well at the goal of serving primarily Pacific islanders, and it is likely that none ever will. First, expatriates have a stronger motivation to talk to the outside world, in order to keep in touch with their home cultures. Second, many indigenous users come to the network specifically intending to reach non-islander expertise in America, Australia and New Zealand. With this in mind, 50% islander traffic seems a reasonable target.

These "reasonable goals" can be combined to compute an idealized success index.

Scheduling efficiency	(% of time used)	75%
Admin. Efficiency	(% of time for content)	80%
Design Efficiency	(% teleconference)	90%
	(% participants)	75%
	(% islanders)	50%
Success Index		.20

(Kangaroo Net, excluding islanders = .40)

An ideal/real ratio then gives an indication of network effectiveness of 35% for the Micronesia and PEACESAT networks (7/20), 42.5% for the Kangaroo net (17/40) and 55% for the University of the South Pacific (11/20), which indicates considerable room for improvement.

Some cosmetic improvements could be made immediately. For example, the New Zealand terminal, which accounts for a considerable portion (25.6%) of the Peacesat network, could be run by a Maori rather than a caucasian, and the Hawaiian terminals, which account for 22% of all ATS-1 traffic, could be staffed by native Hawaiians, rather than caucasian- and Japanese-Americans. This would improve the "islander" traffic considerably, but it seems a bit of a racist over-reaction. For example, does Stuart Kingan, a New Zealander who has made his hone in the Cook Islands for almost 40 years count as an islander or a caucasian? How should Dr Steven Seumahu, a native Spice-Islander residing permanently in Australia, be classified?

Real and permanent improvements will require deeper thinking and coordination. Are there users in French Polynesia who could make better use of the morning time which is too early for most of the Pacific? Do the Australian and Micronesian networks need technical assistance to finalize their plans to use the evening (0800-1100 GMT) times, or could potential users in Asia make better use of these time slots? What combination of administrative procedures and data transmission, could be devised to reduce on-air administrative time? What kinds of public relations out-reach and user training could be devised to increase the activity of conference participants?

Answers to the hard questions that are needed to bring about real and permanent improvements in ATS-1 traffic are being continually sought by terminal operators and network management. The process might be hastened by some assistance from NASA and the University of Hawaii Social Science Research Institute, which handles the scheduling of ATS-1 for NASA. Organizations such as the Pacific Telecommunication Council, New Zealand's Department of Industrial and Scientific Research, America's Public Service Satellite Consortium and Australia's Satellite Users Organization, as well as the national telecommunications agencies throughout the Pacific, all have considerable expertise to assist in this endeavour.

However, no amount of work will still the basic criticism that ATS-1 is an "elitist" medium. With 50 terminals sharing overlapping memberships in five different networks, on a single channel satellite operating in simplex mode to support open-access and educational teleconferencing, it can never be anything else. It can not hope to be an open-access interpersonal medium, such as the telephone, nor can it act as a conventional radio station. The ATS-1 networks are "quasi-mass" media, which function somewhere between an interpersonal medium and a mass medium. The nature of quasi-mass media requires a large proportion of administrative time and entails a tendency towards elitism, even though this may be contrary to the stated goals of the media operators. (Lange, 1984)

The Pacific nations have a wide range of technological sophistication. Most Australians can't imagine how they would get along without a telephone, while many Micronesians are still extremely uncomfortable about the idea of using one. On the other hand, the Pacific island nations have been using a satellite for tele-teaching for a decade, while Australia's school-of-the-air is still using ham radio rigs. One person's high technology is another's primitive gadget. Although ATS-1 was the peak of new technology 20 years ago, today a VHF transponder used as a single voice channel is considered mildly amusing by those dealing with multi-transponder satellites which offer a thousand voice-circuit equivalents per transponder. The concept of live operators devoting circuit time to helping participants overcome communication anxiety and to locating unnamed parties who mgiht be interested in the topic of discussion has an almost ante-diluvian air.

However, ATS-1 does offer over 20 solid hours of high-content teleconferencing each week, ranging from technical conferences on solar energy applications to the exchange of recipes for traditional foods, from physicians' seminars on gynaecology to village literacy training. Since no other satellite agency can, or will, connect the islands nations of the Pacific in conference-call roundtables, ATS-1 is the only game in town. If some of the problems which face the network planners can be overcome, it may provide a sound base on which to build subsequent networks on more sophisticated communications sytems.

ATS-1 DATA EXPERIMENTS

Students who begin first grade in 1984 will graduate from college in 2001. Whatever else is required at the millenium, a person unable to access and control information stored in computers will be able to function about as well as a person who cannot read and write today. This is as true in the Pacific islands as it is in the major metropolitan centers of the world. Unfortunately, the information age costs money: to gain functional literacy with data base access and telecomputing requires practice with a computer and a telecommunications link, just as traditional literacy requires practice with a book or journal.

Student needs are not the only compelling reason for connecting computers to the ATS-1 network: social service agencies - suffering under extremely slow and unreliable mail systems - wanted electronic mail, schools wanted access to data bases and larger computers than were available on their island, instructors wanted to share modifications made to CAI course-ware to adapt it to the Pacific cultural millieu. At current international telephone rates, none of the Pacific institutions could afford experiments over commercial carriers.

In light of the extremely low budgets and limited technical skills available to ATS-1 earth stations, design characteristics for the data communications system were restricted to (1) inexpensive, off-the-shelf equipment which (2) requires little maintenance and (3) can be used for other purposes when off line. Previous work on the Aloha Network (Abramson, 1973, 1977; Wax, 1974) and the Montreal Packet Net (Roleau & Hodgson, 1981) was instructive, but beyond the price of most ATS-1 operations. Lange, et. al.(1984) describes the ATS-1 data experiments summarized below in more detail.

In 1980, USAID provided the University of the South Pacific with equipment to conduct experiments with data communication. With these systems as a base, the ATS-1 computer group standardized on Apple II computers and DC Hayes Micromodems, connected to existing transceivers through Kenwood PC-1 phone patches. These are suggested standards only; other computers and 300-baud modens are acceptable provided they use US ASCII with 8-bit, no parity data transmitted at American standard tones. (This causes some problems, since Australia and New Zealand use a different standard.)

Most commercial modems are designed for duplex rather than simplex operations, requiring some kind of interactive "handshake". These otherwise sensible safeguards frustrate communication on simplex channels where keying the microphone mutes the receiver circuit, which the computer system interprets as a disconnection. John Lovell, then at the University of the South Pacific, discovered two modifications which defeated the "carrier dectect" circuit on the Hayes Micromodem. With these modifications, a simple 10-line Basic program then permits data transmission over simplex circuits, but it is limited to 9600 bytes per transmission and requires an unwanted degree of operator interventions.

The experimenters selected Southeastern Software's Data Capture 4.0 as a good communications program that was cheap, had a relatively high capacity (21,000 bytes) and was easy to operate with little training. Peter Scannell (University of Hawaii) modified it to allow the program to operate on a simplex circuit with frequent static bursts, and this has become the ATS-1 network standard. The error rate in the ATS-1 data system (0.5%) is adequate for text, but is too high for executable code or for important applications such as payroll or data processing. Ed Houlton (Hawaii Institute of Geophysics) has written a tell-me-three-time error correction program which compares three transmissions, character by character, and outputs any two that agree. This system is easy to operate, but reduces throughput by 2/3. Obviously, more work needs to be done on error correction.

The ATS-1 data group plans several more experiments in the coming year to improve data communication in the Pacific. (1) Four hours of overnight time (1300-1700) is reserved for a store-and-forward network operated by unattended computers transmitting in pre-timed slots. (2) The Hawaii Institute of Geophysics will seek to match their transmitter to within 3db of the sending station, allowing full-duplex communication on the "class C" transponder using two frequencies. (3) Peter Spooner (South Australia College of Advanced Education) will attempt to design a low-cost simplex modem with an RS-232 port that is switchable between American and CCIR standards. (4) Several of the eastern terminals will be attempting data links between ATS-1 and ATS-3, which would make hard-copy communication possible from Thailand to Jamaica, and points between. (5) Norm Abramson's ALOHA group is planning further packet broadcasting experiments, using a commercial satellite, which would operate simultaneously (inter-leaved) with voice traffic without degrading perceived signal quality. With the dramatic decrease in microchip prices, they aim for a system affordable to the low-budget user. The authors of this paper welcome further suggestions for data communications experiments on ATS-1.

THE FUTURE OF ATS-1

NASA estimates that the satellite should hold station until at least 1993. As NASA phases out its tracking stations, in favor of TDRSS, control of ATS-1 will be passed to the Hawaii Institute of Geophysics, with a possible secondardy station in Australia. This will ensure that the Pacific islands will have access to the satellite for an extended series of trials.

Current plans include making use of the essentially dormant time from 0800 to 1800 GMT for course delivery in Micronesia (0800-0930), for education and public broadcasting in Australia (0930-1100), for Asian terminals (1100-1300) and for unattended computer store and forward traffic (1300-1700). However, NASA has been very generous in its donation of ATS-1 for operational (as opposed to experimental) uses on PEACESAT, it may come under some pressure to revert to more esoteric technical experiments by the growing community of Pacific telecommunication scientists.

ATS-1, particularly the University of the South Pacific and PEACESAT networks, have demonstrated that VHF technology can be used effectively for tele-teaching and for interest-group networking. The data experiments have shown the potential of this medium for electronic mail slow-scan TV and other low-speed (300 baud) computer communications, and planned experiments should move this work to the operational level in the coming year. However, the basic problems connected with a VHF satellite that is used in a low-power, narrow-band operating mode will not go away. Signal quality will continue to be poor, and can be expected to deteriorate as the batteries and solar cells gradually decline. Similarly, the scheduling problems will increase, as more users become aware of the ten-year life span prediction and the desire to experiment with telecommunications is stimulated by the growth in INTELSAT, MARISAT, AUSSAT, PALAPA and Japanese systems.

There is a move among interested parties in the Pacific to reserve the frequencies and orbit space of ATS-1 at the coming WARC meeting. If successful, vastly improved versions of this inexpensive and simple technology might be piggy-backed on a coming generation of satellites, allowing many networks which could serve even the extremely small islands with surface areas of less than a mile and populations in the hundreds. But any plans for future generations of satellites are extremely long range. In the meantime, the most logical step is to attempt to use the successful ATS-1 model over an existing, high-quality satellite. Currently, INTELSAT has the widest coverage in the Pacific, and it is chartered specifically for such international services.

FROM PEACESAT TO INTELSAT

The Pacific island nations are the smallest and most isolated on earth. More people attended the World Cup match than live on Guam (pop. 100,000). More people work in the Pentagon Building than live in the Republic of Belau (pop. 14,000). As a result, these nations have little power, beyond the strategic value of their ports, to attract attention for their economic, political and social interests. Yet, together, they comprise over 5 million people with a multi-billion dollar economy. Obviously, if they could speak with one voice, their ability to control their own destiny would be improved. Unfortunately, it is difficult for them to speak with each other at all, much less to speak in concert on a given issue.

One reason for the success of ATS-1 is that it uses a mode of communication that is common to the Pacific: group discussion to consensus. However, the current political atmosphere and commercial pricing structures make it difficult for Pacific islanders to reap the benefits of existing facilities, much less plan for new systems. In fact, these islanders are trapped in a "catch 22": they need better communication to cooperate, but they must be able to cooperate in order to get better communication.

Many of the metropolitan countries' governments do not see limited inter-island communication as a bad thing. For example, the United States and Japan have strong interests in Pacific fishing, mineral and dumping rights, and so are not particularly interested in about "law-of-the-sea" or "nuclear-free Pacific" exchanges. However, these quibbles may be minor in comparison to internal barriers.

The colonial history of the Pacific is the largest impediment to better inter-island communication. Micronesia, Melanesia and Polynesia have been isolated from each other by government tradition as well as by distance. Since the French, English, and Germans saw themselves as rivals, it was natural that their colonies began to perceive themselves in this way too. Even with a desire to co-operate, the differences among French, British, Australian, and New Zealand administrative and trade practices are large enough to ensure misunderstanding in most mutual endeavors.

Even the many organizations which are committed to improving inter-island communications are often at loggerheads. The Pacific Post-Secondary Education Council (a consortium of American-flag territory colleagues), the University of the South Pacific (a nine-nation cooperative effort) and the PEACESAT Consortium Council (an association of ATS-1 users) all desire to improve inter-island and inter-group activity. Yet each also views the other as a competitor for the scarce resources of international recognition and grant money. Similarly, the South Pacific Commission, the Pacific Forum, and the Pacific Basin Development Council (inter-governmental institutions) have mutual interests and even share over-lapping membership, yet they often vie for each other for supremacy on a given issue.

A large part of the reason for this internal division is that the Pacific islanders have had little opportunity to talk to each other and formulate joint plans. Agencies take contradictory positions before they know that another agency even has an opinion. They often compete with each other for small grants simply because there has been no chance to coordinate the project as a regional effort that could attract more substantial funding.

One solution would be to establish a social service satellite network, after the ATS-1 model, using the INTELSAT system which is now available in most Pacific island nations. Technically, this system could be put in action tomorrow, using SCPC's (single-channel-per-carrier modules) tuned to the same frequency, in effect using the satellite as a permanent teleconferencing bridge. This kind of party-line architecture has been used effectively in educational projects and it has been granted a special rate structure by INTELSAT.

The potential benefits of such a network are myriad. Reliable data communication would provide fast and efficient mail systems that are essential for joint planning, as well as experimental access to data bases and data-processing. Voice, data and slow-scan TV could be joined to enrich island education, bringing in "visiting" lecturers from other islands and around the world, joining students and faculty studied similar subjects in a Pacific-wide community of scholars and allowing citizens to study needed specialties without the disruption of leaving their home environment.

Perhaps more importantly, such an experimental network would provide a working demonstration of the value of new communication technologies which could be used to train local government, business and public service personnel. Such training should stimulate innovative approaches to a wide range of common problems facing the Pacific islands, and thereby increase telecommunications traffic and revenues.

A sample network schedule, using a five-time-zone base, would look something like this:

Western Terminals		Eastern Terminals
0000-0700	Computer Traffic	0500-1200
0700-0800	Public Health	1200-1300
0800-0900	Pan-Pacific Gov't	1300-1400
0900-1000	Primary Education	1400-1500
1000-1100	Secondary Education	1500-1600
1100-1200	Social Services	1600-1700
1200-1300	Farm/Fish Extension	1700-1800
1300-1700	Tertiary Education	1800-2200
1700-2400	Computer traffic	2200-0500

The cost of such a network can be estimated, making a few assumptions. COMSAT cites a tarrif of $1125 per class-A half-link. The Guam Telephone Authority quotes $7.50 per mile per month for a lease line, and the average distance between island educational institutions and INTELSAT earth stations is 10 miles. Granting these assumptions, the per-island cost of transmission is $14,400 per year. Adding a person to run the network brings the price to about $35,000.

At these rates, the system would easily pay for itself. For example, Saipan pays about $46,000 each year in post-secondary course delivery costs (air-fare and per diem for visiting instructors). If these teachers were brought in once at the beginning of the semester to meet the students, and once at mid-term to renew the personal contact, these delivery costs fall to about $11,000. Thus Saipan would save enough in tertiary education to pay the entire systems operating costs. If 10 major user groups could be found on each island, each would pay $3500 per year, which is about the cost of three round-trips between American Samoa and Hawaii.

However, current pricing structures place such a service well out of reach for most governments and social service agencies. For example, the University of the South Pacific uses ATS-1 for teleteaching among nine islands. When they requested a commercial service to replace this experimental system, the local quote was $350,000 for 15 hours per week of audio-conferencing. That is about 23 times the cost based on the assumptions made above. Obviously, the telecommunications corporations, the governments, or both, view external communications as a massive generator of revenue which can be used to subsidize other operations.

The major problem is that party-line networks bring in less revenue per unit time than the current point-to-point commercial rates. This barrier is particularly annoying, since there is considerable spare capacity which no one is now buying, and this spare capacity is likely to increase dramatically in the coming decade. The social service agencies who would experiment with the proposed network cannot justify the current rates, but as they became aware of the benefits of teleconferencing and data communication, they would generate new budgets and grant proposals to find the money to buy these services. Hence, far from competing with commercial carriers by drawing off potential revenue customers, such an experimental network would increase telecommunications business over the long-term.

If this theoretical business multiplier is to work, there may need to be some changes in the traffic-based rate structures that are the current wisdom. For example, a call from Guam to Truk (600 miles) costs $4.00 per minute, while a Guam-US call (6,000 miles) can be had for $1.50 per minute. Incidentally, RCA Global Communications, which handles most of Guam's external telephony, declines to quote for a multi-island conference call. As long as these kind of policies prevail, the average citizen, non-profit service agency, small business and even government department will be priced out of inter-island telecommunications.

And things may well get worse before they get better. Several entities have made competing proposals for satellite systems to serve the Pacific islands. A recurring nightmare is that all of these proposals might be carried out. We might see Micronesia on INTELSAT, Papua-New Guinea on AUSSAT, half of Polynesia on TDRSS and the other half on the Japanese system proposed by RITE (Takasaki, 1983). With this kind of confused competition, the Pacific islanders would be able to communicate superbly wither every one in the world. Except each other.

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APPENDIX

THE KANGAROO NETWORK
(22.5 hours/week)

The Australian version of PEACESAT is called the Kangaroo network. It was initiated by LaTrobe University, among others, to give small users some first-hand experience with satellite telecommunication which has been lacking in Australia, but which has great potential for educational and public service activities. The Kangaroo net philosophy is to give as many individuals and institutions as possible the opportunity to promote experiments and demonstrations in satellite telecommunications, though not to the exclusion of, or competition with, established terrestrial systems.

The objectives of the project are to (1) encourage experimentation to discover applications most appropriately served by satellites, (2) assist small users to articulate and convey the needs for appropriate facilities on board domestic and international satellites, with particular attention to AUSSAT, (3) discover and assist the development of potential satellite user groups, and (4) participate in current experiments within the Pacific-wide ATS-1 system.

The network consists of three types of ground stations: regular, occasional and special sub-net. There are 8 regular stations active on a daily basis, representing each of the Australian states: The University of Sydney, Latrobe University, the South Australian Education Technology Centre, The University of Western Australia, Darling Downs Institute of Advanced Education, Darwin Community College, the Australian Maritime College and the Australian National University.

Occasional stations include portable units owned by Latrobe University and the South Australia Educational Technology Centre, and permanent rigs at the Western Australian Institute of Technology, the South Australia College of Advanced Education, Deakin University, the Canberra College of Advanced Education, Mitchell College of Advanced Education, Bruce College of Technical and Further Education, and Footscray Institute. These stations operate on an irregular basis in the Kangaroo net, and have access to Pacific-wide ATS-1 networks on request. Eighteen further stations have been proposed throughout Australia.

Several subnets in the Kangaroo network are allocated time on a priority basis:

PACNET (packet switching network): data experiments among Sydney University, Latrobe University and Tohoko University in Japan, coordinated by Dr. Ian Parker, Sydney University Computer Science Department.

PRIMARY-SECONDARY EDUCATION: Exchanges among Australian and Pacific Island schools, coordinated by Colin Dunnet, South Australia Educational Technology Centre.

NATIONAL POLICE SATELLITE TASK FORCE: Experiments in emergency communication and law enforcement connect 5 stations at Warilla (Woolongong), Collingwood (Melbourne), Maylands (Perth), Winnellia (Darwin), Brisbane and Canberra, coordinated by Ray O'Grady, New South Wales Police.

TERTIARY DISTANCE EDUCATION: teleconferences and seminars in distance education connect the Darwin Community College, the University of Western Australia, the Western Australia Institute of Technology, the South Australia College of Advanced Education, Deakin University, Latrobe University, the University of Guam, the University of the South Pacific, the University of Hawaii and Massey University, coordinated by Dr. Kevin Livingston, Darwin Community College.

WESTERN AUSTRALIA EXTENSION NETWORK: connects the Western Australia Institute of Technology with study centres in Bunbury and Kalgoorlie, coordinated by George Idle, W.A.I.T. External Studies.

NORTHERN TERRITORY SCHOOL OF THE AIR: Experiments in conjunction with existing HF network, coordinated by Dr. Norm Bowman, Northern Territory Department of Education and Mike Forster, Katherine School of the Air.

BATCHELOR COLLEGE: aboriginal teacher education network, coordinated by Peter Plummer, Batchelor College.

PUBLIC BROADCASTING NETWORK: experiments in program exchange which includes station 3RRR-FM, 6UVS-FM, 2NCR, 8TOP and Radio II SER-FM and existing ground stations at Latrobe, Perth, Macquarie and Lismore, coordinated by Keith Jackson of SER-FM and Brian Walsh of the Public Broadcasting Association. (currently inactive)

QUEENSLAND STATE NETWORK: Intra-state coordination of educational, social service and public safety activities. (Proposed)

Overall coordination of the Kangaroo net is provided by Dr. Steve Seumahu of Latrobe University's Department of Electronic and Communication Science and Dr. Peter White of Latrobe's Media Centre. Latrobe University is responsible to NASA for the use of the ATS-1 satellite in Australia. Equipment at Latrobe is partially funded by the Australia Radio Research board and coordination activities are supported by a grant from the Commonwealth Advisory Committee on Educational Uses of Communication Technology.

THE MICRONESIA NETWORK

In 1978, the US Department of the Interior established a network to assist in the administration of the Trust Territories of the Pacific Islands (Micronesia). This network was used to connect hospitals, schools and administrative centres, as well as to support Peacecorps (the US volunteer service agency) activities in the region. It was used for inter-island communication and for communication to the United States through the Public Service Satellite Consortium's ESOC in Denver. By the time the satellite was moved out of range of the Denver station in 1982, traffic had dwindled to daily telephone patches between the Ponape political status commission and their representatives in Hawaii and Washington. In the meantime, Mike Caldwell (University of Guam) took the initiative to begin an educational and public service network, combining features of the PEACESAT and USP nets, using the time which was left vacant by the earlier department of the Interior users. These early efforts included audio teleconferencing, slow-scan television, data communication, and even some television experiments via ATS-6. The satellite was used for course delivery and administrative planning within the regional Pacific Post-secondary Education Council, a consortium of schools in the American-flag territories.

In 1983, the PPEC took full control of the former Department of the Interior time to establish the Micronesian version of PEACESAT, called Micronet. The Network consists of terminals in the higher education institutions in Saipan, Yap, Guam, Truk, and Ponape. Plans are underway to restore the terminals in Palau, Kosrae and Majuro to operational status. Current users include the Consortium of Pacific Arts Councils, the Secondary Education Curriculum Project, the Headstart (primary school) programme, the ATS-1 Computer Project and the Federated States of Micronesia Political Status Commission, in addition to the PPEC members. Each Micronesia station also takes part in the PEACESAT network, finding participants for Pacific-wide conferences of local interest.

THE OCEAN NETWORK
(12 hours weekly)

In 1976, Paul Eden (University of Miami) began systematic use of ATS-1 to reach oceanographic research vessels at sea. Eden's concept spread to the University of Hawaii, where the Institute of Geophysics now runs a voice-and-data network to service its fleet.

ATS-3 is used for this purpose wherever possible, since it's transponder allows several users to operate simultaneously, and at a higher power than ATS-1. As a result, the signal quality and reliability on ATS-3 is better than on ATS-1, and it is the satellite of preference for the oceanographic communications network. However, west of about 170 degrees east longitude, ATS-3 gets too close to the horizon for reliable communication, so only ATS-1 can be used for vessels in Micronesia and beyond.

The Ocean network is an operator-run system which connects communication workers so that news, mail and data can pass between the ships and the home base. The Hawaii terminals will also put individuals on the ships into direct contact with third parties in Hawaii and the US mainland for both business and personal calls.

THE PEACESAT NETWORK
(30 hours per week)

PEACESAT stands for the Pacific Education and Communication Experiments via Satellite. Its primary objective is to study the benefits of audio teleconferencing among groups of common interests in the widely separated countries of the Pacific. PEACESAT's hope to find a model for future worldwide networks for the exchange of knowledge and ideas in education, health, science, community development and other social services.

Purely PEACESAT terminals are located in Honolulu, Wellington, Lae, Noumea, Raratonga, and Pago Pago, with a former ATS-1 terminal in Santa Cruz (California) that joins in via ATS-3. The University of the South Pacific was one of the original pioneers of the experiment and members of the USP net are also members of PEACESAT. Terminals in the state capitals of Micronesia and Australia are also regular PEACESAT members, while the other stations in the Micronet, Ocean Net and Kangaroo net have access to PEACESAT on request. Twenty-two terminals are actually polled in the daily roll call.

PEACESAT "prime time" runs from 0200 to 0600 GMT, on Mondays and 0300 to 0500 on Tuesday through Sunday. These hours are coordinated by Elsa Flavell from Wellington Polytechnic. Early morning times (1900 to 2200) are only useful to the eastern terminals and are shared with the USP net. The PEACESAT hours are coordinated by Teriapi Kingan from the Cook Islands government station. Coordinators note requests for teleconferences, discuss such requests with the other terminals, allocate network time, ensure that agendas are distributed, monitor exchanges, assist participants and train conference leaders and network staff.

Organizations wishing to use PEACESAT request a teleconference from the local terminal manager, who explains procedures and the time constraints of the network. The terminal manager will evaluate the request in terms of both the preparation and the likelihood of finding interested participants on other islands, and assist the requestor in ensuring maximum participation. Requests of a personal, commercial or propgandistic nature are denied.

All requests are discussed at a weekly scheduling meeting, and if participants in other islands can be found a planning session is scheduled. Planning sessions are chaired by the request initiator, but include the terminal managers as well as the potential participants. The schedule of meetings and agendas for the first few meetings are established, and terminal managers work to ensure that the participants meet their initial objectives. This includes training participants in radiotelephone procedures, typing up agendas sent over the satellite and making several reminder calls to participants just prior to the actual teleconferences.

Most teleconferences are on-going series, rather than a one-time only meeting, although the latter are not discouraged. After an initial period of about six months, conference participants are left to their own devices to ensure that their sessions continue to function. Some series have continued or several years, while others fade away as soon as the terminal staff cease doing most of the planning and organizational work. Some of the sessions scheduled for 1983 include:

Computer Experiments....	weekly
News Exchange...........	"
Building Engineers...	every two weeks
Seagrant................	"
FAO Root Crops..........	"
Girl Guide Leaders......	monthly
Boys Brigade Leaders....	"
Community Planners......	"
Reproductive Health.....	"
Renewable Energy........	"
Tropical Fruits.........	"
Pacific Recipes.........	"
Home Economists.........	6 weeks
Vulconology.............	"
Y.W.C.A.	"
Commonwealth Youth......	"
Tongan Ministers........	2 months
Natural Family Planning.	"
Catholic Bishops........	occasional
Pacific Archives........	"
Medical Engineering.....	"
Primary School exchange.	"
High Schools exchange...	"

New exchanges are started continuously, such as the recent Asia-Pacific Regional Information Network, which links interested islanders with agricultural and scientific specialists in New Zealand, or the Red Cross monthly sessions which puts local workers in touch with their counterparts in Australia. Some of these series operate on time borrowed from other networks, such as the Turf Management monthly session on Kangaroo net and the occasional meetings of the Pacific Islands News Association. Similarly, PEACESAT terminals are frequently made available to people who would like to participate in regular series on other ATS-1 networks.

THE USP NETWORK
(20 hours weekly)

The University of the South Pacific serves the Cook Islands, Fiji, Kiribati, Nuie, the Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa. The main campus in Fiji joined the PEACESAT network in 1972, and established its own network in 1974. The experimental purposes of the USP net were to: (1) identify the effective uses of an audio link, (2) establish distant classrooms for external studies, (3) support continuing education programs via teleconferencing, (4) conduct joint curriculum planning and development and (5) provide rapid exchange of administrative information.

The system is used for teleconferences to support governmental and community activities among the nine member nations, but most of the time (78.7% in 1980, according to the USP) is devoted to external studies. In 1981, the network supported 46 courses, enrolling nearly 2000 students. These students come from islands where there is little tradition of tertiary education and totally inadequate library facilities. Secondary education is highly teacher-dominated and students have little experience with independent study. They share English as an inter-island language, but it is a second or third language and not well mastered. There are rich oral traditions, but little mass media, so the cultures vary widely from island to island. Regardless of educational achievement, employment opportunities are severely limited.

These conditions place a heavy load on tutorial services and demand special design in courses, support materials and feedback systems. Specifically, USP found that their external studies courses required (1) copious guidance instructions on the use of printed and taped support materials, (2) a local facilitator to control meetings and assist the students, (3) specific student response assignments which are required to be completed before taking part in the tele-tutorials, (4) direct, immediate and regular interaction between the students and the major tutor and (5) frequent and rapid interaction between the local facilitators and the distant administrators.

Over the past 10 years, the University has developed some basic principles for tele-teaching via ATS-1: (1) more than 2[illegible] participants at more than 5 terminals is difficult to handle, (2) to maintain student interest and motivation, tutor communications must be short (3-5 minutes) and followed by student discussion and interaction, (3) local facilitators must actively assist and encourage shy students and those with language difficulties for full participation to occur, (4) students must undertake some course-related preconference activity immediately prior to the tele-tutorial, (5) good discussion flow depends on tutors preparing a program outline for each exchange, (6) tutors must be trained to replace gestures with voice inflexion to express enthusiasm, interest and sympathy, (7) tutors must be trained in ways to stimulate discussion among groups that they have not met and cannot see, (8) the relationship of each teleconference to the course must be specific and clear, (9) tutors must remain flexible to meet changing student needs as the tele-course progresses and (10 local facilitators must help students clarify their needs prior to the tele tutorial.

Prior to 1978, the USP net followed the PEACESAT system of conference initiation explained above. This was found to be unsatisfactory since (1) spontaneous exchanges were easily dominated by the more articulate, (2) a lack of clear objectives produced insufficient information for decision making, (3) exchanges were mounted on topics which were to esoteric to be of interest to more than a handful of island residents, (4) various participants often had very different specific interests in a given topic and hence felt a lack of commonality with the others, (5) a small cadre on each island tended to be involved in many different exchanges, resulting in network monopolization and information overload for some of the participants, and (6) the lack of advanced programming made planning the allocation of scarce personnel resources at the terminals difficult.

In 1978, Maurice Apted established a structure for the USP exchanges which required (1) submission of a written program proposal, (2) an exploratory staff meeting to discuss the proposal, (3) recirculation and discussion of the proposal rewrite (if necessary), and (4) a planning meeting with the proposed participants before a session would be allowed on the air. While this structure increased the amount of staff time necessary prior to actually running a conference series, it ensured proper planning so that the series itself ran with less staff involvement, and the written proposal was more easily evaluated by potential participants.

Each proposal includes (1) the reasons for the conference, (2) statement of objectives, (3) detailed description of possible participants, (4) suggested format of the discussions, (5) suggested program agendas, and (6) evaluation procedures. These procedures have reduced the number of requests for teleconference series and may have changed the nature of those people and organizations who apply. However, as noted earlier in this paper, of all ATS-1 networks, the University of the South Pacific's network has the highest proportion of teleconference time as opposed to point-to-point time, and the second highest proportion of content time as opposed to administrative time.

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The Development of
The Local Administrative Information System

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1. Abstract

The Local Administrative Information System is an on-line system which enables communication between the center and branch offices and to which various public services can be applied. It has many advantages such as an acceleration in business transactions and a reduction in personnel expenses and the public is provided with improved governmental services. This paper introduces an outline of this system.

2. PREFACE

For the last 10 years, government expenses have accounted for 20 percent of the total Japanese GNE. Obviously government plays a major role in the social and economic development of Japan. Moreover, judging from Premier Nakasone's January speach on administration policies regarding welfare, this important role will be strengthened, and efficient public service management is even more vital to the future of Japan. In the past, local governments have attempted to improve the efficiency of their governmental affairs and have put many plans into practice, for example, introduction of a facsimile system. However, most of these efforts have been to little avail. Although, as expected, computer systems have been quite effective, because of technical difficulties, computer usage is still in a primitive stage and highly efficient on-line systems are just being introduced. NTT is fortunate in having much experience with these on-line systems and is putting its knowledge to use in the development of the Local Administrative Information System. This system should be most beneficial in promoting efficient and well coordinated government service provision. Many other countries attending the PTC also require more efficient public services. It is my opinion that NTT's Local Administrative Information System will be very instructive for these countries in improving the efficiency of their governmental affairs by adopting on-line systems.

3. PURPOSE OF THE SYSTEM

This system has many advantages such as an acceleration in business transactions and a reduction in personnel expenses. Ultimately, public is provided with improved governmental services. In addition, this system also has database files which store all citizen information that might be needed by local administrations, such as citizen documents, tax affairs social work, education and public health services.

System design began on December 16, 1981 and concluded on April 1, 1983.

4. OUTLINE OF THE SYSTEM

(1) SYSTEM CONFIGURATION

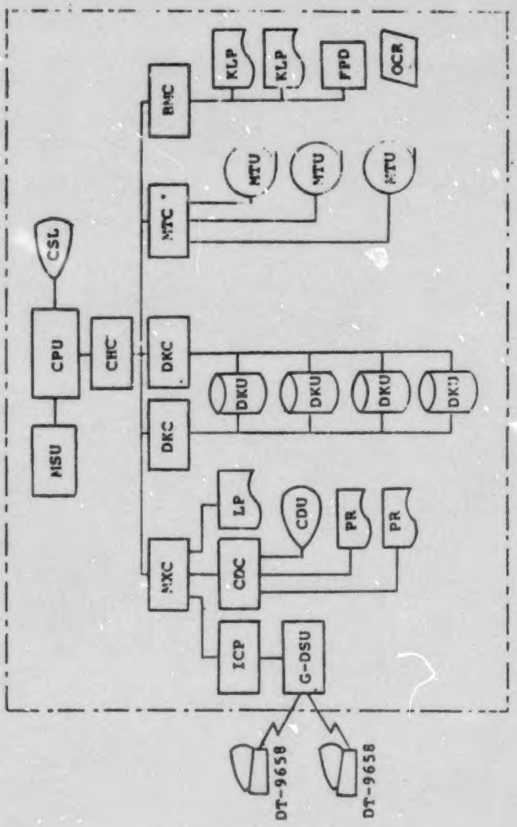


Fig. 1. System Configuration

A. CENTER

This center consists of a medium sized computer, disk units, magnetic tape units, Kanji (Chinese character) line-printers and other units.

B. TERMINALS

DT-9658 Data Communication Terminal Equipment (for the purpose of Kanji-input) is used as the main terminal equipment and is also provided to branches and other places.

C. LINES

DT-9658 Data Communication Terminal Equipment is connected by data communication lines (for 4,800 bit/sec).

(2) SOFTWARE CONFIGURATION

The software configuration of this system is shown in Fig. 2.

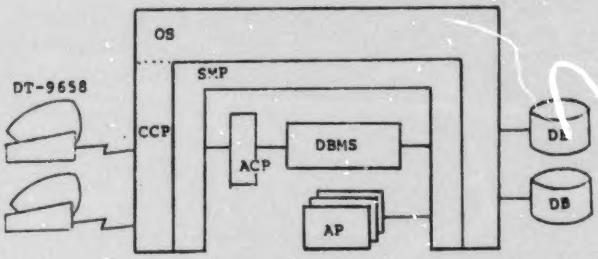


Fig.2 Software Configuration

OS:(Operating System)
CCP:(Communication Control Program)
ACP:(Application Control Program)
DBMS:(Data Base Management System)
AP:(Application Program)

(3) SYSTEM USAGE AND PROCESSING MODE

A. CITIZEN DOCUMENTS

a. Transferring basic citizen ledgers to on-line files, this system manages citizen information (for example, household relocation, deaths and births) in an on-line processing mode.

b. It also compiles various statistical data in an off-line processing mode.

Contents of processing and modes are shown in List 1.

List 1. Citizen Documents

Contents	Mode
(1) Information processing of citizen documents	On-line
(2) Inquiries	
(3) Other activities	
(1) Creating poll books	Off-line
(2) Generating ballots	
(3) Other activities	

B. TAX

Transferring basic tax ledgers to on-line files, this system quickly carries out tax affairs.

Contents of processing and mode are shown in List 2.

List 2. Tax

Contents	Mode
(1) Inquiries	On-line
(2) Issuance of a tax certificates	
(1) Creating taxation ledgers	Off-line
(2) Impositions	
(3) Other activities	

C. NATIONAL HEALTH INSURANCE

a. Transferring policy holder ledgers into system files, this system processes various policy holder transactions in an on-line mode.

b. Transferring levy ledgers to system files, this system processes imposition data in an off-line mode.

List 3. National Health Insura[illegible]

Contents	Mode
(1) Processing policy holder changes	On-line
(2) Inquiries	
(1) Impositions	Off-line
(2) Receipts	
(3) Allowance payments	

D. NATIONAL PENSION INSURANCE

a. Transferring policy holder lists to system files, this system processes transactions in an on-line mode.

b. A large variety of notices and announcements concerning these activities is processed in an off-line mode.

List 4. National Pension Insurance

Contents	Mode
(1) Processing policy holder changes	On-line
(2) Inquiries	
Notices	Off-line

E. WELFARE

Related welfare affairs and inquiries concerning qualifications are processed in an off-line mode.

List 5. Welfare

Contents		Mode
Welfare of the aged	(1) Help with medical expenses	Off-line
	(2) Allowance payments	
	(3) Other activities	
Welfare of phisically handicapped people	(1) Registration	
	(2) Allowance payments	
	(3) Other activities	
General assistance	(1) Registration	
	(2) Allowance payments	
Child welfare	(1) Allownce payments	
	(2) Other activities	
School Assistance	(1) Registration	
	(2) Allowance payments	

F. Education

Related educational affairs are processed in an off-line mode.

List 6. Education

Contents		Mode
School	(1) School children's lists	Off-line
	(2) School admission notices	
Kindergarten social education	(1) Registration	
	(2) Other activities registration	

G. SANITATION

Related sanitation activities are processed in an off-line mode.

List 7. Sanitation

Comtents		Mode
Conpensation for environmental pollution	(1) Registration	Off-line
	(2) Allowance payments	
	(3) Other activities	
Health examination	(1) Health examination for the elderly and infants	
	(2) Vaccinations	

5. SYSTEM FEATURES

As the Local Administrative Information System is based on citizen information, it is natural that this system requires correct and simple Kanji-processing as well as a mechanism for the protection of citizen's privacy.

(1) HIGHLY EFFICIENT KANJI ON-LINE PROCESSING

For Kanji-processing of names, addresses, etc., this system incorporates not only the JIS Letter-Set (2,802 letters) but also the Expanded Letter-Set (4,267 letters) and further incorporates User's Letter Set (1,880 letters) for extra assurance.

This system has two methods of Kanji-input. One is tablet and the other is Kana-Kanji conversion. Thus, these are advantages such as an acceleration and simplification in Kanji-input processing. Also, this system can provide complete Kanji-processing for all local administration affairs by making a complete Kanji-data base.

(2) UNIFICATION OF CITIZEN INFORMATION

By person's linking master files of each affairs, this system can uniformly manage citizen information and avoid any overlapping of citizen documents.

(3) PROTECTION OF PRIVACY

Every possible measure (for example, maintenace of correct data and prohibition of leaking data) is taken to protect citizen privacy. To be more specific, this system establishes a terminal-equipment identification code and limits operaters and processing functions through it.

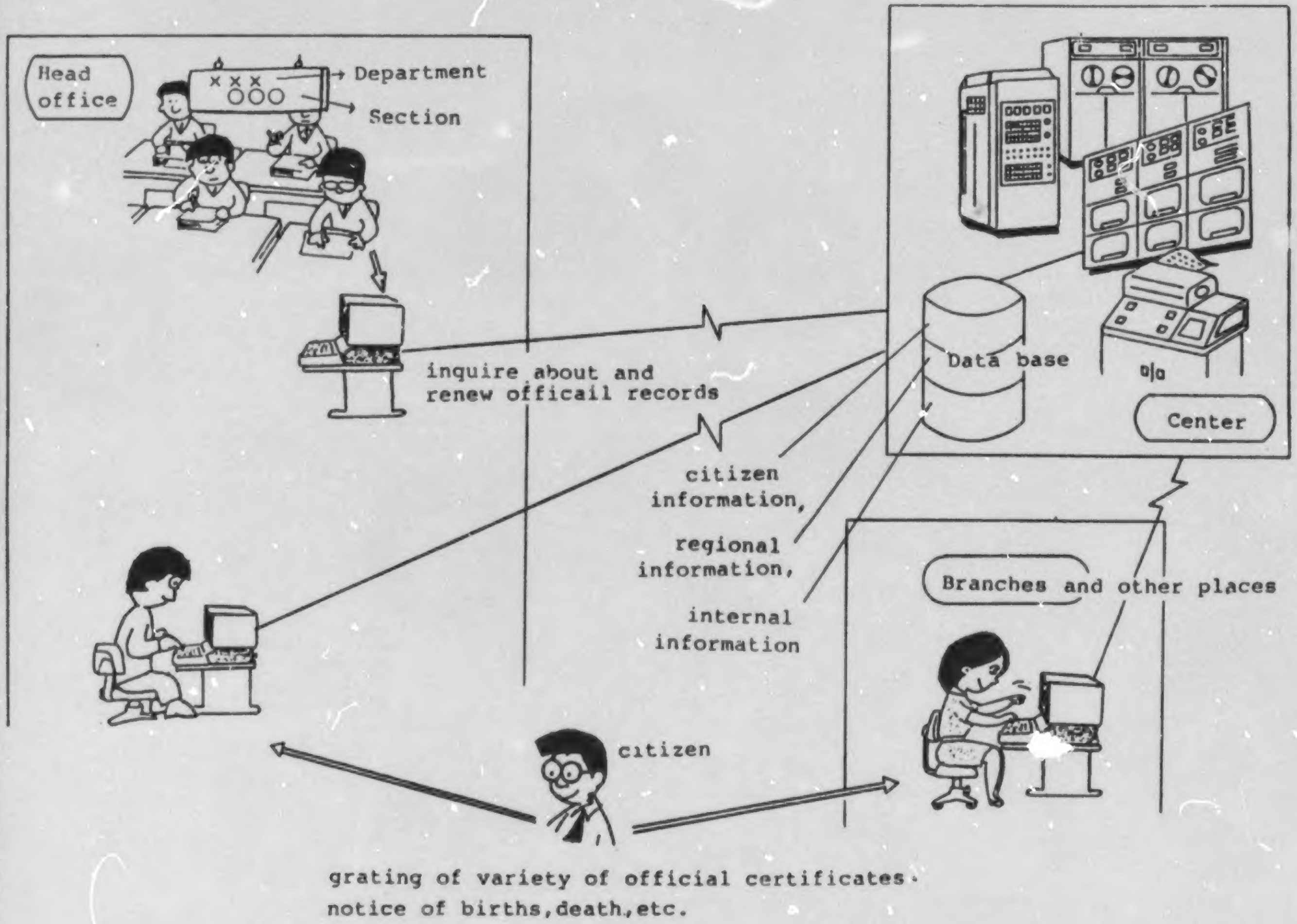
(4) EXISTING SYSTEM COMPATIBILITY

At present, many local administrations process their affairs through off-line systems based upon Kana-letters. NTT has developed the Local Administrative Information System on the assumption that it will be applied to many local administrations. Therefore, it has been developed to accomodate existing processing forms and systems.

6. FUTURE SCOPE

In the next stage of the Local Administraive information System, NTT plans to develop a seal-register system, for which a leading image-processing technique will be introduced.

Addendum: Outline of The System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citizen
grating of variety of official certificates·
notice of births,death,etc.

International Tele-Education: An Imperative for Meeting Educational Needs

Herschelle Challenor, Bert Cowlan, Lynn Fontana, Jane Hurd,
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Abstract

Tele-education is not a new concept. Projects employing communications technology for educational purposes have existed for decades. Current trends in education and the realities of the political, social and cultural environment have stimulated concern for the future of such efforts and promoted further examination of ways in which communications technology can be employed to meet basic educational needs. This paper looks at the issues associated with tele-education and poses suggestions for action.

Introduction

In March of 1983 a Workshop was held in Washington, D.C. to assess the present status and explore the future of the use of technology to produce, distribute and exchange educational programs and ideas internationally and intranationally. Workshop participants were educators, technologists, broadcasters and business people who represented diverse international, educational, nonprofit, broadcast and commercial enterprises with interest in the topic. Many of the participants were young and relatively new to the field. Others were not so young and have been intimately involved in many tele-education efforts over the years. The group spent three days hearing about past efforts, successes, failures, emerging issues and prevailing needs. While confusion characterized the conference, several things were clear throughout the discussions.

- Much has already been learned from past efforts about how to, or perhaps how not to, use communications technology for educational purposes.
- The lack of follow-up and the failure to transfer knowledge and build upon experiences from one project to the next frustrates newcomers and veterans alike. A more systematic means of sharing information about tele-education projects with colleagues around the globe is needed.
- A history of tele-education is needed to explicate what has already taken place and what works, where and under what conditions.
- Some international structure, however fluid, is needed if tele-education is to advance effectively from its infant state to maturity.

With these concerns in mind a group of the participants agreed to volunteer some time and effort to help foster the concept of tele-education. The Committee for International Tele-Education was formed, committed to the idea that the educational use of existing and emerging communications technologies should be explored and promoted. In pursuit of this goal, the committee identified the following activities to advance the field:

- Publish the papers from the workshop for wider distribution.
- Assess the need, internationally, for a coordinating network which would serve as a clearinghouse for information, an advocate for tele-education programs and a provider of related services not available from existing organizations.
- Develop a directory of existing organizations that have interests and involvement in international tele-education.
- Publish a history of tele-education.

While pursuing these four activities the steering group of the Committee for International Tele-Education is meeting monthly to discuss possible activities, recruit more members and identify funding sources. At this point the committee is reaching out to a broad international audience to find others who share their concerns and enlist their help in shaping some future organization or activity.

This paper is designed to stimulate thought and action on the part of colleagues around the world, and in the Pacific, and hopefully recruit their assistance. The authors of this paper present a rationale for tele-education, review selected tele-education projects, discuss the political, social and cultural barriers that inhibit growth of the effort, and posit suggestions about possible steps for advancing international tele-education for reaction and comment.

Rationale

The pursuit of tele-education is mandated by the fact that the information age is upon us. The social, economic and political impacts of advanced communications technology are already being experienced worldwide, but educational institutions have not yet adequately responded to the challenge of technology.

- Instantaneous, global communication systems make it possible for millions of people worldwide to view events while they are happening, no matter how far the viewers may be from the event.
- Information "leaks" constantly from one part of the world to another whether there is an effort to control its spread or not.
- New multi-million dollar industries have emerged to produce the hardware and software to drive the communications age.
- From the bush of New Guinea to the concrete jungles of New York City human beings are being faced with the new options, changes, threats and hopes offered by the communications age.

The possibilities for the future are many. Some are positive and hopeful, while others are distasteful and depressing. The information age could be an era in which the highest humanitarian goals of healthful, joyous fulfilled lives are achieved by millions of the world's population. It could be an era of global peace and understanding. On the other hand, the information age could be just another opportunity to exploit the already exploited and provoke international intrigue and distrust. While the ultimate outcomes of the information age will be determined by many factors, there is the possibility that efforts towards international tele-education could help shift the direction of the information age, however so slightly, toward the positive and hopeful by promoting the use of communications technology to improve understanding among people, share valuable educational resources and generally improve the status of humankind.

The Use of Tele-education in the Pacific and Other Parts of the World

The twin problems of the inability to finance sufficient classrooms for a burgeoning and often decentralized population and the need to keep abreast of rapid developments in all fields of human endeavor have caused many countries to seek solutions through the use of telecommunications technology.

Distance teaching began as early as 1880 when a Swedish teacher, Hans Hermon, provided instruction to a student who had moved by sending lessons through the mail. In 1911 the University of Queensland pioneered post-secondary level external studies in Australia when 3 of its 83 students enrolled in a distance education program. Countless other early examples abound of educators' efforts to reach out to far-off students.

Since the late 1960s we have witnessed a dramatic expansion of the use of television, radio and other communication technologies to deliver educational messages. Radio was first used to support education in schools in the mid 1920's. In fact by 1939, 10,000 schools possessed radios in the United Kingdom. Literally thousands of adult education listening groups grew up in Britain in the 1930's. The radio farm forums which developed subsequently in Canada, India and Africa reflect the transfer of radio education to other parts of the British influenced world. By 1937, New Zealand formally linked radios with correspondence education. Curiously, the United States, Britain itself, France and the Federal Republic of Germany did not follow this model until the mid 1960's. In the mid sixties newly independent countries sought to broaden educational opportunities at lower costs, and when the first communication satellite was launched in 1965, widening the possibilities for radio and television transmissions over large distances, we began to witness accelerated interest in what is now known as tele-education.[1]

Today, the developing countries of Latin America and the newly independent states of Africa, the Caribbean, the Middle East, Asia and the Pacific islands face high illiteracy rates, spiraling educational costs--in some cases amounting to 25% of the annual budget--a small, inadequately trained educational manpower base and an intensifying demand for more and better education. Most developing countries interested in tele-education view communications technology as a means of servicing a variety of educational needs at all levels at lower per unit costs, rather than as a mechanism for providing education only to small disadvantaged or remote groups of people. Therefore, tele-education has been introduced to help obtain junior or high school equivalency degrees, to complement adult literacy programs, to train teachers and literacy workers and, to deliver quality education.

Often, fascination with the medium has brought people to a listening center; while desire to become literate or improve their educational level has kept them there.

Although a variety of patterns exist, in large measure tele-education programs in developing countries are sponsored by governmental authorities such as the Minister of Education or Social Development working in cooperation with national broadcasting facilities. In Latin America, religious groups and private foundations have sponsored several of the education projects. As one would expect in the United States, local public and private bodies, particularly universities, have been involved in educational television and radio programs, frequently with federal government financial support. Lately, examples of cooperation between non-profit and commercial entities have begun to emerge. With literacy programs, usually the broadcasting network or services has had full or partial responsibility for program content. In cases of shared responsibility the other partner generally has been an educational institution. With dual sponsorship, reconciling the different perceptions and methods of educators and broadcasters has been an issue of concern.

A review of the use of terrestrial (cable, wire or microwave) communications systems and satellite transmission of television and radio educational programs reveals that the greatest strides in developing countries have been taken in Asia (particularly India), the Pacific Islands, Indonesia, and in Latin America, notably in Brazil, Mexico and the Commonwealth Caribbean.

Africa[2]

At least fourteen African countries have used radio and to a lesser extent, television, since the mid 1960s to assist national literacy projects, to transmit development information to rural areas and to facilitate teacher training (Cameroon, Central African Republic, Chad, Congo, Ethiopia, Gabon, Guinea, Ivory Coast, Kenya, Madagascar, Mali, Niger, Senegal, Sudan, Upper Volta and Zambia.) Ethiopia and Ivory Coast both initiated significant programs as early as 1963.

The Ethiopian Ministry of Education launched seven small pilot projects which used simulated radio programs recorded on cassettes for classroom instruction in 1963. This experiment was financed by private funds and subsequently by the government of the Netherlands. In addition, the government aired a weekly half-hour radio farm program three times a week which provided information about new agricultural techniques. Later, Ethiopia started a very successful large-scale radio and television program for literacy instruction.

Ivory Coast was the first sub-Saharan African country to use television on a wide scale for educational purposes. The Audio-visual center of the Ministry of Defence, Youth and Civic Service undertook a pilot program which used closed circuit television for literacy programs. By October 1964 the program was expanded to include daily literacy lessons in French for 1,000 workers who followed these courses in centers. Monthly television programs for teacher training were soon established and, with the assistance of UNESCO, the Ivory Coast, began using television for primary and post secondary school instruction. After several years, Ivoirians cut back their use of televised instruction for schools for a variety of reasons including inadequate maintenance of equipment, some concern over program content and insufficient coordination of television programs with direct classroom teaching.

The recently completed International Telecommunication Union (ITU) study on satellite use in Africa and several other comprehensive studies[3] which are still in progress may provide African nations with greater more versatile options for tele-education in the future.

Asia

The existence of large populous states in Asia and the far-flung settlement patterns of the Pacific islands may account for the great interest in tele-education in that region. Apart from Australia, India, Indonesia and the Pacific Islands have been the leaders in this area. Burma, Laos, Taiwan and Iran have also developed significant programs using televised and broadcast instruction.

India pioneered in the developing countries of the region with the establishment of about 200 radio listening clubs prior to 1956. Subsequently, a radio farm forum pilot project using techniques developed in Canada for adult education was instituted. By 1965, All India Radio was broadcasting rural educational programs in all languages and 30 dialects from 30 stations. To ncrease the listening audience, the government provided nearly 200,000 community radio receivers to the villages through a special subsidy scheme. The farm forum program became a pivotal component of a joint UNESCO/FAO project in India called "Farmer Training and Functional Literacy."

In one of the most far reaching educational experiments to date, India initiated the one year Satellite Instructional Television Experiment (SITE) in July, 1975. Using the NASA Applications Technology Satellite (ATS-6), India provided educational programs in all languages to 2,400 rural villages. The programs covered such areas as national integration, education, mathematics, health, nutrition, family planning and agriculture. Subsequently, educational programming continued over India's experimental communications satellite, APPLE. With the successful launch of INSAT in 1983, even broader use of educational programming via satellite is anticipated.

Indonesia was the first third world country to develop its own satellite system and use it subsequently for educational purposes. Since the launching of the first PALAPA satellite in 1976, Indonesia has used this system to provide not only telephone, telegraph and telex services on a commercial basis, but also to broadcast a variety of educational programs throughout the country. The Ministry of Education created a educational technology center to train the manpower necessary to make full use of the satellite system. A new project underway in

1983 will establish an audio conferencing system and facsimile capability to link the eight campuses of the Eastern Islands University Association, one of its extension centers and the Bogor Agricultural Institute. This system is designed to expand distance teaching and will involve faculty training and sharing of research findings and library holdings. The U.S. Agency for International Development has provided assistance for this project as part of its Rural Satellite Program.

The Pacific Islands[4]

Broadcasting has long been a tool for isolated educators in the Pacific islands. Where other communications facilities are lacking, central education departments broadcast messages to principals telling them when to come to town to fetch either supplies or information too complicated, too lengthy or confidential to to be broadcast.

Since 1969 the National Aeronautics and Space Administration has made available for a series of expermental communications projects its ATS-1, an experimental geostationary satellite launched in 1966. Three networks, USPNET, the University of the South Pacific Network; PEACESAT, the Pan Pacific Education and Communication Experiments by Satellite and DISP, the Department of the Interior Satellite Project Network have used ATS-1. Though the signal from the geriatric satellite is no longer sufficiently predictable for actual sustained classroom use, occasional lectures and invaluable administrative, health care and agricultural information is still transmitted.

USP provides an illustration of the far-reaching uses of satellite technology. The University's enrollment is about equally divided between its 1,400 full time and 1,300 extension students. Over 60 percent of the extension students are scattered in USP's 11 countries and 11 million square miles of ocean. In 1974, at NASA's invitation, USP established its own experimental network to test the effectiveness of satellite educational activities for the regional university. Since then, USP has used ATS-1 to offer as many as 23 hours of voice interaction for credit courses, tutoring sessions, adult education courses, conferences, administrative sessions, and also a computer link every week between the 9 extension centers and the University's main campus at Suva, Fiji. Slow-scan video units have been install in Fiji, Tonga and Western Samoa, but there has been reluctance to complicate the situation with television whose marginal use has not been central to the educational goals of the University.

The major disadvantage of this program has always been that University authorities cannot encourage outer island students to take degree courses because they do not have the benefit of the satellite.

The continued use of ATS-1's essentially no-fee service has become an issue of concern to the international carriers who believe that present ATS-1 transmissions should be absorbed by commercial communications systems. A tariff for an audio point-to-multipoint service has been established by INTELSAT. Critics insist that the cost to public service users is prohibitive. Clearly, there is no incentive to cross over to the commercial system as long as ATS-1 provides a usable signal.

Latin America and the Caribbean

Tele-education is widespread n Latin America and the Caribbean. Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Cuba and Jamaica figure among the countries that have established active programs. Particularly notable among these programs are those in Brazil, Mexico and Jamaica. With the increasing demand for high school certification in Brazil, distance teaching using radio and television became an integral part of the educational system beginning in the mid-sixties. Since the initial efforts by the Fondacao Educational Padre Landel de Moura (FEMPLAN), other private institutions, state and federal authorities have established a variety of educational programs using communications media.

The federal government launched the Minerva Project in 1970 to provide: supplementary instruction including printed texts, to decide upon the educational programs to be bradcast on television and radio five hours a week, to train teachers for the tele-education program at the state level and to produce other educational and cultural programs.[5] Under Phase II, which started in 1973, the project was to provide educational programs for radio and television that covered the last four years of primary education. By 1978 the Minerva project had involved over 300,000 students. The printed texts for the program have been designed carefully so that each chapter corresponds to the material in one radio program.

Minerva has made it possible for students who had been shut out of the educational system to obtain an elementary education. However, since the fixed costs for this program are high, it is necessary to attract at least 100,000 students in order to maintain a favorable cost-benefit ratio.

Brazil is in the process of developing its own satellite system. At present in the Latin American region, Argentina, Brazil, Chile, Colombia, Mexico and Peru all use INTELSAT for the distribution of domestic television services.

In Jamaica, use of radio and television education programs began in 1967 following a small pilot program on closed circuit television initiated in 1966 by the Literacy Section of the

Social Development Commission. The television programs were aired on the one national channel and the radio programs were broadcast on Radio Jamaica and Rediffusion (RJR) and Jamaica Bradcasting Corporation (JBC), a commercial and a public station respectively. These transmissions cover about 80 percent of the population and were initially designed for target group audiences of 10,000. The programs were prepared by the Social Development Commission in consultation with the JBC, the Univeristy of the West Indies Radio Unit and the Jamaica Information Service.

Jamaica has exercised leadership in a project that will bring a satellite-based audio teleconference system to the Univeristy of the West Indies. This project has evolved from a short eight week satellite pilot project in 1978 using ATS-3 and ATS-6 and a two year university directed feasibility study. Under this project the University's three principal campuses in Jamaica, Barbados and Trinidad will be linked with the extension cneters in Dominica and St. Lucia. The system will involve facsimile, telewriters, computers and perhaps slow-scan television and will be used for university creadit courses, non-degree courses and for agriculture extension services. Like the project at the University of the South Pacific, this program receives financial support from the U.S. Agency for International Development.

United States

In the United States five[6] examples of the applications of telecommunications in education emerge as possible models. Among these are the National University Teleconferencing Network, based at the University of Oklahoma; the Campus Conference Network, a project of Services by Satellite (SatServ) which is owned jointly by the Public Service Satellite Consortium and Fairchild Industries; the International University Consortium; the Adult Learning Service of the Public Broadcasting Service and the Learning Channel, formerly ACSN.

The National University Teleconferencing Network (NUTN) links university campuses for the provision of teleconferencing services. Originally, 47 universities banded together to determine how to take advantage of high technology. After the first year of operation, and nearly doubled membership of 90 institutions committed to sharing programs, NUTN officials are convinced of the network's value to higher educational institutions. Awareness of NUTN's programs has grown. Others beyond the university community have expressed interest in using the universities' continuing education facilities to receive NUTN's programs, and initial contacts have been made for the commercial use of NUTN.

Due to initiate service shortly, the Campus Conference Network has planned from the outset for the commercial use of its facilities. CCN will link 50-60 university and college campuses where earth stations, manufactured expressly for this network by Fairchild, will be erected. CCN will provide video teleconferencing services for all sectors of the sixty major metropolitan ares where these primary sites, or Affiliates, are located. Secondary sites, or Associates, will also be established to connect campuses in less densely populated areas. CCN facilities and services will be available to the entire community, making this perhaps the most ambitious effort to date to link educational institutions with the for-profit activities of the communities in which they are situated. The colleges and universities will for the most part own their own earth stations. They will share in the revenue from teleconferences and are welcome to use the facilities for their own programs at times not reserved for CCN transmissions.

The goal of the International University Consortium for Telecommunications in Learning is to create easy access to high quality baccalaureate programs through television-assisted independent study. Television is used by IUC as a pacer or motivator rather than as a didactic tool. Before changing its title to reflect the internationalizing of its scope and the membership of two leading Canadian distance learning institutions of higher education, the former National University Consortium was the first national adult education organization to adapt the concepts and course materials of the British Open University to meet the needs of American higher education. The International University Consortium enables established colleges and universities to offer high-quality bachelor's degree programs for part-time adult students in a cost effective way offered through a mechanism adapted to the structure of American higher education and U.S. television.

The Public Broadcasting Service (PBS) reaches 88 million or 94% of the households across the United States. Viewers throughout the country can gain credit for courses based on PBS broadcasts through its Adult Learning Service. Public television stations have contact persons who go into the community to familiarize officials at nearby colleges and universities with the Adult Learning Service programs. During the first year of its service, an estimated 1.6 million households tuned in to the Adult Learning Service. A year later, a million additional households joined in. In its third operational year over 100,000 students enrolled in courses based on the Adult Learning Service through close to 700 colleges and universities, and the average number of students enrolled is increasing. An Adult Learning Service official said recently that its programs bring a new luster to educational television.

Next fall the Adult Learning Service is launching a national narrowcast service which is aimed at meeting the many needs of colleges and universities that cannot be served through open channel broadcasting. PBS stations will deliver feeds directly from satellites to places where adults congregate such as libraries and work sites.

The Learning Channel supplies its affiliates--17 colleges and 515 cable companies--with 74 hours a week, seven days a week, of programming. With a large older adult audience, the Learning Channel provides programs on subjects from languages, automotive repair, music, and government, to engineering, parenting and drug abuse. The Learning Channel was established exclusively for and is dedicated to life-long learning for the 60 million people it wants to serve in the next five to ten years.

The programs offered by these five institutions have harnessed technology to meet the educational demands of large numbers of people. These programs serve to illustrate a variety of innovations that can be employed to ensure that variations in educational demands can be met adequately in this country. The challenge remains to adapt these models--both programmatic and technological--to meet educational needs of learners elsewhere in the world.

Conclusions

A review of over twenty years of experience with educational television and radio and a brief look at new and innovative programs reveals a number of factors. We have found that the indirect audience is larger than the direct one but that such programs have a greater impact on group audiences. In certain Arab countries, for instance, women viewers, an indirect group which listens to or watched programs at home, numbered twice as many as those groups who visited centers for direct viewing and other related instruction.

A second predictable finding was that when both television and radio are used, television emerged as the senior partner, attracting larger and more faithful audiences.

Frequently, the adequate maintenance and servicing of broadcast equipment surfaced as the weakest link in the chain of operations involved in tele-education projects. As the technology becomes more sophisticated, in many cases maintenance will mean only the changing of circuit boards, leaving technicians with fewer difficulties than expected. Nevertheless, it remains that insufficient attention has been paid to training and providing adequate staff for both the technical and programmatic aspects of production.

Tele-education programs have been more successful in cases where group viewing/listening is available as a pacing or motivating tool along with regular discussion of program content. Teachers must be carefully trained, and program materials must relate to the everyday life of the students. Tele-education programs are most successful when feedback on program impact is coordinated nationally and cooperation with several national organizations, whether government or private, exists. Finally, successful projects include the practical particpation of the groups they were designed to serve.

In contrast, problems have emerged in cases where the content of educational broadcasts have been overly theoretical and not relevant. Both appropriate technology and appropriate programming--relevant to the needs of the audience--are necesary. Many programs have started without sufficient research and planning and have suffered from unsuitable management. As a result, the hostility that has sometimes developed between educators and broadcasters has proven detrimental to overall efforts. Care must be taken to ensure that the responsibilty for educational programs is not divided among too many organizations without proper coordination.

With respect to using satellites for the transmission of radio or televised educational programs, a clear examination of costs is required. Satellite transmission works well because it is distance insensitive and is cost effective when covering large areas. The constant evolution of satellites and other telecommunications technology has tended to produce lower costs and wider variety of educational possibilities. There is no reason that education should be denied access to the newest technological innovations; neither is there anything incompatible about using high technology to deliver education to audiences in developing countries as long as the programs that the technology delivers meet the needs of the target audience, are presented in a language and a cultural context appropriate to that audience, and the telecommunications facilities extend sufficiently into rural areas to meet the real education needs. Above all, fascination with the technology should not minimize the need to engage in careful planning and significant training of the human resources necessary to implement successful tele-education programs.

The Challenge of International Tele-Education

The use of communications technology for educational purposes is clearly not new. However, it is also clear that tele-education is wrought with many problems and issues which are not likely to dissipate if they are not addressed directly.

We have been catapulted into a space age, an age dependent on satellites for telecommunications and a variety of other purposes, many of them highly important to our health, wealth, and security as individuals and as nations.

As complex as things have become, it seems appropriate to recall the historical background of the present situation. In a time when satellite technology was new, and the application of this new technology was discussed in terms of its social significance, the benefits of space technology were not as obvious as were the threats, especially because the technology had been born of military needs and midwifed by the cold war.

It did not take long for the UN to realize that the use of satellites was an arena in which it might play a significant role, and it began to devote time, effort, and money toward that end. UNESCO saw a major role for itself, which eventually contributed substantially to the development of the controversy over the "new world information order." As time passed some interesting shifts in emphasis occurred as to which technology was of greatest value. At the UN's first conference on The Exploration and Peaceful Uses of Outer Space in 1968, the assumption was that the prime interest would be in communications. Remote sensing, however, was seen by some key officials of that conference to be of greater importance.

The fashion changed not long after and communications, especially the potential for direct broadcast television satellites became a major--if not the only--issue. DBS continues to arouse passion and fear, and remains a subject of contentious debate and recrimination. The UN's General Assembly (responding to the "larger social/economic/political world context") recently passed a series of resolutions. While the resolutions have no binding force in international law the fact remains that the UN, insofar as it represents the developing world, is thinking about--and clearly favors--a regime of prior consent where direct satellite broadcasts are concerned.

Discussions of the use of advanced communication technologies for education in the international arena must be put into the proper perspective. No technology is politically, socially, or culturally neutral and the fact that education and information are being transmitted more frequently by increasingly more sophisticated technology only emphasises what some see as the potential danger of tele-education. It is no wonder that the developing world fears what Thomas McPhails calls "electronic colonialism."

The political, social and cultural nature of the questions surrounding tele-education are not the only inhibiting factors in developing the full potential of technology for education. Past efforts have frequently been marked by exaggerated promises of what the technology can do. These projects were often doomed to failure because monetary resources were used to insure the development of the best hardware at the expense of developing appropriate human infrastructure or software.

Educational television was brought to one French-speaking African nation, for example, by UNESCO. Being Francophone, the educators and programmers were French, most likely graduates of some Haute Ecole Superieur. The chairman of the Scientific/Technology Advisory Committee was the Deputy Minister of Primary Education" who was by self-admission not an educator but a "simple farmer." The purpose of the the programs they created was to teach farmers techniques for growing more and better tomatoes. When the programs were aired the village farmers looked on in confusion and interest but were never able to apply the lessons. They never increased the productivity of the local tomato paste factory beyond a third of its capacity. It was obviously the wrong lesson, perhaps conceived in ways that could not be understood by a village farmer .

Outcomes of projects like the one described above raise some questions about what people learn and how they learn from mediated instruction, particularly when cultural difference and ignorance are so apparent. A Soviet delegate to the UN once explained that what people in the Third World fear is not necessarily what is featured, but what might be learned from background settings. His example: The Soviet Union would not be afraid to carry "Dallas." But, if in a scene in some program or other, assembly line workers streamed out of a factory and got into their private cars in the parking lot, much damage -- in the Soviet context -- could be accomplished. In a scholarly sense, this goes back to Dan Lerner's "revolution of rising expectations." And consequently, the possible causative effect of media upon that revolution.

The political and social issues associated with tel-education are further exacerbated when the vast number of languages to be accommodated is considered. In Africa, for example, there are 800,000 villages south of the Sahara in which close to a thousand languages (not dialects) are spoken. It is difficult to imagine a technological configuration that could adequately address the problems of communication among these peoples, no less the other political and social factors.

Perhaps Joe Pelton and Bob Filep summed up the plethora of problems associated with tele-education most succinctly in their paper for the March Workshop:

> The problems to be overcome in developing effective satellite-delivered educational services are considerable. We have noted the following problems: (1) the difficulty of designing effective, two-way, point-to-multipoint and interactive networks well-suited to the community; (2) the issue of ownership and control of these transmission facilities; (3) the tendency to design systems that place too much emphasis on satellites and earth station terminals and not enough on terrestrial redistribution, user receivers and terminals, and especially, software and human resources; (4) the difficulty of importing and translating educational materials and programs developed for another country or culture; (5) the

> tendency to exclude teachers and users of educational materials from program development; (6) the tendency to use a communications service or technology in a particular environment that is more expensive or sophisticated than is necessary or cost-effective; (7) a tendency to underestimate the "soft" costs of an effective satellite-delivered educational service, such as maintenance costs and training of teachers, field workers and technicians; (8) the tendency of satellite manufacturers and terminal equipment suppliers to "oversell" their product; (9) the barriers to accepting a new way of educating students or adults; (10) the tendency of advocates of satellite education to promise more than is possible and, at times, to present a program so that it is seen as threatening to cultural values or even job security; and (11) the still relatively high cost of many satellite-delivered programs, particularly when less than a million students are involved.(7)

Many of the educational problems which the peoples of the world face are obvious, even if the issues are not very clear. Education, no matter what the culture, should provide citizens with the economic, social and political skills to survive as members of national and international societies. The technological capability to address these problems in a manner appropriate for the information age already exists, and the potential has already been demonstrated, but the barriers to effective technological utilization are formidable.

The present situation is much the same as that described by Albert Einstein when talking about another revolution, "Everything has changed except the mind of man." It is relatively easy for a planner to call for "newthink" but a bit harder to suggest how to go about it. There are no clear-cut answers and perhaps no obvious first steps, just the realization that there is an opportunity.

Sharing ideas, experiences and resources in search of the most educationally beneficial ways to utilize the technological capabilities of the age seems imminent and the only way that the barriers can be overcome, but that assumes that the opportunity is recognized.

What Next?

The impact of the information age has been pervasive and difficult to comprehend. In a recent article in Intermedia, Edward Ploman, Vice Rector of the United Nations University in Tokyo noted:

> This fundamental change in, or attitudes towards, the communications/information complex is so recent that we still seem very unsure about what it means and how to deal with it.(8)

According to Ploman emerging approaches to knowledge are holistic rather than departmental. In this move toward greater unity he calls attention to the potential in the information age of inter-cultural integration of thought.

> At the frontier of knowledge is the need to learn not to judge the population of insights, practices and mental patterns produced by human societies but to inter-breed them, to establish so far untried communication between them.(9)

This kind of internationally integrated thought is difficult to dispute as an ideal, but the realities of the current economic, political, and cultural climate may well dictate compromises for those of us concerned about the educational use of communications technology. The fact that the ideal may be beyond the realm of the possible, however, does not mean that it should not be an objective. There is an opportunity to move toward the ideal; by recognizing the realities and drawing upon lessons learned from past and present projects there are appropriate actions waiting to be taken.

The discussions at the March conference identified some immediate needs which can only be effectively addressed by trans-national and cross-national efforts. Many questions about the educational use of communication technology have yet to be answered and no system presently exists to make what is already known readily available to those who wish to know it. Future progress in the area will undoubtedly be determined by the degree to which new projects build upon the success and failures of the past, rather than being doomed to repeat the same mistakes for the lack of knowledge.

The Committee for International Tele-education hopes to stimulate action by inviting colleagues around the globe to join them in establishing an agenda for research and development in tele-education and in promoting an ongoing dialogue on the educational use of communications technology which addresses the issues being generated by the information age.

Research questions which might be part of this agenda include:

- How do people learn in mediated instructional setting? What cultural, economic, and social factors determine the educational effectiveness of mediated instruction?
- How can educators(teachers, administrators, support staff) at various educational levels and in different settings be better prepared to maximize the benefits of communications technology for education?
- How can educators, communications experts and policy makers in various cultures be brought together to make more effective decisions about the educational application of communications technology?

Development projects to accompany the research might include efforts to develop:

- Models for creating and sharing educational material,ideas and resources cross-nationally, trans-nationally.
- Models for training educators in various setting to use communications technology effectively for educational purposes.
- Models for policy decision making that involve educators, communications experts and government officials.

Efforts to establish an ongoing international dialogue on the educational use of communications technology might include:

- Organizing a "shirt sleeves" conference which brings together practitioners from past and present projects to share ideas and resources.
- Organizing a decision makers conference in which leaders at the highest levels in education, communications, and policy making would meet to discuss why tele-education is important and how they might become involved in promoting these efforts.

There is an opportunity now to influence the shape of the information age by focusing on tele-education in the international arena, but it is an opportunity which could be missed .

The authors of this paper invite your comments, suggestions and involvement.

FOOTNOTES

1 See discussions of this evolution in Hilary Perroton ed., Alternative Routes to Formal Education: Distance teaching for School Equivalency. A World Bank Research Publication. Baltimore & London: The Johns Hopkins University Press, 1982, pp. 8-9.

2 Most of the following data on radio and television literacy projects is from a UNIESCO report prepared by John Maddison, Radio and Television in Literacy: A Survey of the Use of the Broadcasting Media in Combatting Illiteracy Among Adults. Paris: UNESCO, 1969, pp. 6-14.

3 Information on satellite based systems has been drawn from an unpublished paper by Anna Stahmer and Sandra Lauffer, "A New Era of Satellite Communication: Can Education Benefit from it.?" prepared for presentation at the 32nd International Conference of the International Council for Educational Media, Mexico City, October 25, 1982.

4 See the sections on education and the University of the South Pacific in the Pacific Basin Communications Study, Final Report, 2 Vols. Prepared by the Public Service Satellite Consortium for the National Aeronautics and Space Administration and the National Telecommunications and Information Administration, October, 1981.

5 For a full discussion of the Minerva porject, see Perraton, Op. cit., pp. 31-61.

6 These efforts were described at Space Communications in the 80's, a telecommunications users conference sponsored by the Public Service Satellite Consortium and Services by Satellite (SatServ).

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7 See discussion of economic costs and tariffs in Pelton, J. and Filep, R., *Tele-Learning Via Satellite*. prepared for presentation at the Cross-Cultural Tele-Education Workshop, March 1983, p.37.

8 See discussion of two directions in Ploman, Edward W.,"Global Learning", *Intermedia*. July/September, 1983, pp.83-84.

9 See discussion of a new space, Ibid. pp.84-86.

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REPORT ON PEACESAT : 1983

by
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History

In 1970 the U.S. National Aeronautics and Space Administration offered part time use of the VHF transponder on their then four year old Applied Technology No. 1 satellite (ATS-1) to the University of Hawaii for experiments in educational conferencing. Dr. John Bystrom, professor of communications at the U.H., set up a small project linking the University campuses at Manoa and Hilo and the community college on the island of Maui.

The equipment used was designed and set up by Dr. Katachi Nose, professor of physics at the University of Hawaii and a very prominent radio amateur. The communications using initially voice and facsimile, proved very effective.

Then the Wellington Polytechnic in New Zealand became interested and the staff there, headed by the late Tony Hanley, lecturer in physics and electronics, built a unit and obtained permission to join the network. This in 1971, resulted in the first ever international educational communications using a satellite. John Bystrom gave the new network the title of the PEACESAT Project, from Pacific Educational and Communications Experiment via Satellite.

The University of the South Pacific in Suva, Fiji, serves ten Pacific Island nations who contribute to it. Extension courses make good communications essential and the then Vice-Chancellor, Dr. Colin Aikman, saw in PEACESAT an answer to his communications problems. So early in 1972 USP Suva joined the network, followed by their extension centre in Tonga. American Samoa followed, as did the University of Technology in Lae, Papua New Guinea, the administration in Saipan, Trust Territories of the Pacific Islands, and the headquarters of the South Pacific Commission in Noumea, New Caledonia.

Our small scientific research organisation in the Cook Islands was next to join PEACESAT although it had been active on ATS-1 for some time in connection with scientific activities.

By 1975, USP had added terminals in Niue, the Solomons, Kiribati, Vanuatu, Western Samoa and Tuvalu and had negotiated its own time allocations. But all USP stations were also members of the PEACESAT network, which was joined by the University of California at Santa Cruz, the University of Guam, the University of Sydney and for a short time, Simon Fraser University in Vancouver, British Columbia.

Overall co-ordination of network activities remained with the University of Hawaii at Manoa and the chief experimenter, John Bystrom. The responsibility for scheduling was taken by Honolulu, Suva and Wellington in turn, but is now done by Elsa Flavell at the Wellington Polytechnic and Tereapii Kingan at Rarotonga, who schedules morning times used only by stations east of the dateline.

In 1982 a decision on the positioning of ATS-1 had to be made by NASA. It had been kept on longitude 149° West for 15 years but the fuel supply for station keeping was getting very low. Should it be allowed to drift to the gravity valley at 105° West where its sister satellite ATS-3 was already permanently placed or should some of the remaining fuel be used to take it to the gravity peak at 162° East where it could be kept with very little fuel?

At 105° West it would lose contact with Australia, New Zealand and the more westerly of the USP stations, so the decision was made to shift it to 162° East. This operation took most of 1982, but now that it is there, it should be possible to keep it there for many more years.

The shift moved ATS-1 out of sight of the US mainland, leaving Hawaii and Rarotonga as the most easterly stations. However, it brought the whole of Australia and much of Southeast Asia into its coverage. Thirty new terminals have sprung up in Australia. Some participate in PEACESAT exchanges. Others work in later times allocated to the so-called Kangaroo network. The University of Science in Penang, Malayasia, is currently negotiating for the setting up of terminals in Penang, the East Coast of Malaysia, Sabah and Sarawak and times are being reserved for their use in extension education.

The University of Guam and the community college in Saipan are setting up a Micronesia-wide educational network.

Honolulu and Rarotonga can also work on ATS-3, giving coverage of the whole of North America and the Carribean. In fact from these terminals, two thirds of the earth is available with the simple and inexpensive equipment needed to communicate using a VHF geostationary satellite.

In 1979, the PEACESAT Project was transferred from the Communications Department at the University of Hawaii to the Social Science Research Institute at that University. Dr. Bystrom, however, remained as director of the project until 1981 when he was replaced by Dr. Don Topping, head of the Social Science Research Institute. Dr. Topping was also nominated as Chief Experimenter and as such, now deals with NASA on all PEACESAT matters.

Following a request to NASA in early 1982, the responsibility for scheduling of all users on ATS-1 was transferred from ATS Operations Control at Goddard Space Flight Center near Washington to Hawaii. NASA then asked Dr. Topping to take over the responsibility for all ATS-1 time scheduling. This is no easy job, as effectively, ATS-1 has only one simplex channel. With PEACESAT, USP Net, the Micronesian network, the Kangaroo network in Australia, the Pachnet which joins Sydney with Tohuku University in Japan for computer experiments, a prospective Malaysian network and the very important ocean net, which enables the Hawaii Institute of Geophysics to maintain contact with oceanographic research vessels, all requiring time and asking for more scheduling of time, it has not been easy but has been done well on a very cooperative basis with regular inter-network meetings to resolve problems.

For a new network to start or for a new station to join the PEACESAT network, the first requirement is a station licence from the local telecommunications regulating authority. Once this is obtained, Dr. Topping should be asked for permission to join the network and this, in the case of any new country, involves obtaining NASA approval for the new station to use ATS-1. Only when all these formalities have been successfully completed may the new station become operational. The operators of the new station will be introduced to other users at the weekly scheduling meeting and, if a new network, it will be invited to give its schedule each week.

The Technology

The transponders on ATS-1 and ATS-3 are unique in that they use the VHF part of the radio spectrum. On both satellites there is a bandwidth of 100 kHz centered on an uplink frequency of 149.220 mHz and a downlink frequency of 135.600 mHz. The transmitter on each satellite has a power of 40 watts, which is ample to cover the 43 percent of the earth visible to it with a very easily receivable signal. For the uplink, a power of 100 watts into an antenna with a gain of no more than 12 db is ample to saturate the satellite receivers.

No big dishes are required for the antenna--in fact the antenna used normally looks like a rather small T.V. antenna. A four element yagi and pocket sized receiver can pick up a good signal--anywhere in the 43 percent of the earth covered by either of the satellites. Even a good portable receiver with a 19" whip has been used on occasions to listen to ATS-1 in New Zealand. Like the receiver, the transmitter can be very simple. A small solid state amateur transceiver with a suitable small antenna can put a signal into the satellite--with the addition of a small solid state amplifier, a saturation signal can be transmitted to the satellite.

Recently NASA Ames Research Station in California has developed a portable station for use with ATS satellites specifically to show their value in providing emergency communications in the case of a disaster somewhere. This station fits into two medium sized suitcases, quite easily carried. One case contains an antenna which folds out and is set on a tripod. The other contains the transceiver and a computer. The unit can be used for voice or data communications and for power simply plugs into a cigarette lighter socket on a car or a 12 volt battery is carried with it.

When you consider that such a unit can provide excellent communications over 43% of the earth or if used in a site like Rarotonga and Hawaii where both satellites are visible nearly 70% of the earth, you can see just how appropriate for many potential small users such a technology is.

Back in 1972 the U.S. National Public Radio programs were periodically re-broadcast by ATS-1 as an experiment. Although only a hundred watts of power was used for the uplink, the reception over more than 1/3 of the globe on a small receiver and simple antenna was excellent and not subject to the limitations of short wave broadcasting. To acheive the same broadcast coverage with short wave radio would require many megawatts of power and stations in several locations.

The transponder on the satellite itself is very simple. A small solid state unit powered from photo-voltaic cells, it will have been in orbit for 17 years in December (ATS-3 16 years) and is working just as well today as when we first used it. It has, in fact, outlived all other satellite transponders including those launched as much as a decade later.

From my station, using home made and inexpensive equipment, I have communicated with ships, aircraft and even a motor vehicle via ATS-1. When a few years ago an ATS-1 network was formed in Micronesia by the U.S. Department of the Interior, the cost of each terminal complete was $670.00.

Operation of PEACESAT

PEACESAT has provided many different communications services for many different people or groups. But all have the one common factor--that of furthering the flow of information, of helping to inform and educate or to co-ordinate work in the educational social or scientific fields.

All terminals operating on PEACESAT have equal rights--rights to take part in any scheduled conferences or to nominate a subject on which they feel a series of conferences would be of benefit.

One terminal on each network is responsible for scheduling. Wellington, as already mentioned, does the scheduling for PEACESAT afternoon times (0300 to 0500 GMT). On Mondays at 0200 GMT, there is a weekly session when all scheduling stations announce scheduled sessions for the following two weeks. Changes to previously announced sessions or transferring of unused time from one network to another during the coming week is done at that session.

If a potential participant feels that he or she would benefit by a particular exchange, the suggestion is made to the terminal manager who announces the idea at the scheduling session. If one or two other terminals express interest, then a planning session is scheduled in which all interested terminals participate. As an outcome of this possibly a series of six sessions is arranged, usually at monthly intervals. The originator of the session will probably chair the first session and produce an agenda which will be sent out as a message on the network a week or two in advance of this session. The subjects covered are numerous--here are a few examples:

Science:	Remote sensing Volcanology Radio propagation Oceanography
Technology:	Appropriate architecture Renewable energy Water supply problems Preservation of foods Processing of foods Production of wood and charcoal stoves Building engineering
Agriculture:	Tropical fruits Root crop studies Quarantine procedures
Ecology:	Discussions on South Pacific Regional Environmental Program Women's role in environmental protection Ecology of swamps
Culture:	Exchanges on museology Series on museum conservations Discussions on Polynesian languages
Education:	Teaching English as second language Pre-school teaching Social science teaching Exchanges between groups or classes of children (a) High schools (b) Elementary schools
Social Development:	Monthly meetings of Girls Guide (Scout) leaders throughout Pacific Monthly meetings of Boys Bridgade leaders Boy Scouts Jamboree of the Air Women's interest groups Church groups Soroptomist International YWCA Red Cross
Health:	WHO discussions between doctors on epidemiology Discussions on any disease outbreak--arrangment for controlling and localising Consultations in medical emergencies Dental nurses discussions Student nurses exchanges Public health discussions Family planning Nutrition Support of research teams
Information:	Weekly SPC news exchange Special new bulletins from conferences or sporting events Asia and Pacific Regional

Information Network
Journalism training through
Pacific Islands News Association

Politics: Law of the Sea discussions
Discussions between countries on political changes and changes to self government
Discussions on nuclear waste dumping and a nuclear free Pacific
Meetings of Pacific Islands Development Program

These are but a few of the exchanges conducted on PEACESAT. To give a better idea of what is involved, a discussion of how a few of the exchanges work follows.

Volcanology

For several years, monthly exchanges between leading vulcanologists in New Zealand, the U.S., Hawaii, New Guinea and the Western Pacific have been going on. Exchanges are normally proceeded by written papers and are at a very high level. These have left the scientists involved well abreast of developments well ahead of the information in printed journals.

Renewable Energy

Periodic exchanges on this topic have lead to faster progress in the practical field. It was due to discusssions with those interested in the subject at the University of California that the Cook Islands was able to start using photovoltaics for home lighting at a cost effective price more than three years ago.

Tropical Fruits

For several years Dr. Horace Clay of the University of Hawaii has conducted a morning exchange fortnightly with Rarotonga, Niue and Samoa. In Rarotonga, these sessions have been attended by argicultural officers and planters. As a result of these sessions, new varieties of cash crops have been produced and export incomes increased.

Elementary School Exchanges

A school class of a certain age group, say 9 to 11 years, will come to the Rarotonga terminal and have a discussion with a class of similar age in Wellington, Honolulu, Adelaide, in a remote village in the Alaskan Arctic or with another Pacific Island country. They will discuss their school, their sports, their leisure activities, what they do for entertainment—in fact, anything that proves to be of mutual interest. This gives children experience at expressing themselves and teaches them how other people live. Pupils who take part in a session always want to repeat the process and to meet more pupils of their age group overseas. Sometimes they continue to write to each other afterwards.

Girl Guide (Scouts) Meetings

Once a month each of several international youth organisations meet on PEACESAT. For example, the Girl Guide movement, which is strong in New Zealand and Australia and which has branches in most Pacific Island nations, has a monthly session in which news of branches is exchanged and administrative matters for the movement are discussed.

Epidemiology

All health conferences appear really worthwhile, but the system really shows its potential when there is an outbreak of an epidemic somewhere in the Pacific.

When Dengue fever started killing people in Tonga and Fiji, there was very quick international assistance to identify the disease and its carriers and to conduct control measures. All other users gave up time as required for medical traffic and very complicated logistical problems were quickly solved in conferences between medical researchers, doctors, public health personnel and aid donors.

The same procedure followed an outbreak of Cholera in Kiribati which through prompt action and good communications was contained and quickly controlled.

In Rarotonga, an epidemic broke out and was not identified from serum samples sent to New Zealand. The doctor most concerned spoke via PEACESAT to the Infections Diseases Centre in Honolulu, who requested samples of serum, immediately identified the disease as Ross River Fever, and sent a team to help in the control of the epidemic.

Support of Research Teams

This has become a regular use of ATS-1 on PEACESAT and other networks.

Perhaps the most useful example was when in 1975 a team from the National Institute of Health (NIH) in Bethesda, U.S.A. went to study the disease Filariasis on the isolated island of Mauke in the Cook Islands. An H.F. link was set up between Mauke and Rarotonga and through ATS-1, a direct link was set up from Rarotonga to the NIH. As a result of these communications, the whole success of the team was made possible. Without them, the team would not have achieved nearly as much.

SPC News Exchange

In the Pacific Island countries, it is easy to get news of the world; of Australia, New Zealand, the U.S., Japan or any of the rim countries by listening to short wave broadcasts. But it is not easy to get news of other Pacific Islands. This scarcity of regional news lead to the South Pacific Commisssion instituting a weekly news exchange on PEACESAT in 1974. One hour a week is used. Each participating country reads five minutes of news that is considered to be of regional interest and the receiving countries use this in their radio and newspaper coverage. The exchange has proved most useful and has now continued for nearly ten years.

Asia and Pacific Regional Information Network

This monthly exchange, generally referred to as APRIN, was initiated by the New Zealand Department of Scientific and Industrial Research this year and aims at answering information inquiries from scientific and technical persons in the region. At each montly session, a specific topic such as remote sensing, renewable energy, water desalination and supplies on atolls, etc., is discussed. Questions are invited on the topic discussed or on any other topic.

Answers may be given on the air at the next session or simply mailed to the questioner. These answers follow research by the New Zealand Department into all data files that they have available.

Political Discussions

When Niue moved to self-government, their leading politicians had dicussions on PEACESAT with experienced politicians in Rarotonga who have been self-governing for years. Similarly, the Congress of Micronesia in the Northern Marianas had several discussions with the Premier of the Cook Islands before deciding on their political status.

Pacific Islands Development Program Committee

The Pacific Islands Development Program initiated by the East-West Center has a committee which includes many of the Pacific Islands Prime Ministers and is chaired by the Prime Minister of Fiji. Between meetings of the committee at some Pacific country, the committee meets on PEACESAT to discuss Pacific development plans.

These are but a few of the exchanges of information that have given great value to PEACESAT. Here in the Cook Islands the participation in exchanges has been continued enthusiastically for ten years and approximately 10% of the population of Rarotonga have taken part.

TELECONFERENCING: CREATING AN INTERACTIVE COMMUNICATIONS SETTING

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Abstract

The purpose of this paper is to demonstrate how the typical classroom at eight different universities in eight locations was transformed, via teleconferencing, into an interactive communications setting. The University of Toledo along with seven other universities was given the opportunity to explore how telecommunications policy is formulated in the United States. The dynamics of the experiment are contained in this article.

My purpose in writing this article is to demonstrate how the typical classroom utilizing lecture and discussion can be transformed into an "interactive communications setting" (1) via teleconferencing. Although the technology of teleconferencing has been available for almost two decades, it has not been widely publicized or utilized by either industry or higher education until recently. Several reasons come to mind as to why potential users have been reluctant to include teleconferencing in the classroom or business meeting.

One reason might be that prospective users were afraid to employ teleconferencing up to now because they may have been unfamiliar with the state of the art or anticipated a foul-up of equipment that would prevent them from achieving their projected goals. Generally speaking, these fears are unfounded because if one is capable of placing a long-distance call via a Watts number, then he or she should be able to successfully place a teleconference call.

A second reason might be that educators and managers imagined that teleconferencing would not have the impact of the model lecture or the typical interpersonal business meeting. These misconceptions have no real substance and have been gradually disappearing because of the efforts of such organizations as the Center for Interactive Programs at the University of Wisconsin and the various manufacturers of teleconferencing equipment in this country and abroad. A study published last year by *Telcoms* concluded that the application of teleconferencing was expanding in such areas as business, higher education, and in the medical profession both nationally and internationally. (2)

A factor contributing to the broader application of teleconferencing would seem to be the variety and diversity of methods that have become available. The systems, to mention a few, now include slow scan, freeze frame, and, of course, the not-to-be-ignored audio teleconferencing.

Slow-scan video is the least expensive method of visual teleconferencing. Two telephone lines are needed for transmission--one for voice and another for the video image. Although it takes the camera approximately 60 seconds to scan an image, the system is able to offer visual and audio interaction to participants in different locations. (3)

Freeze frame video permits a single frame to freeze and then to be transmitted blurfree to a distant location. Although the picture is better than that of the slow-scan, the participant must still wait patiently for the picture. (4)

Audio teleconferencing is, of course, the least expensive and most familiar form of teleconferencing. It requires nothing more sophisticated than a telephone and/or speaker phone.

The last method, audio teleconferencing, is the one used by The University of Toledo and seven other schools in seven different states which were exploring how telecommunications policy is formulated in this country. Ten minutes prior to the actual teleconference, each location was instructed to dial an operator at an assigned number who completed the conference call or "bridge" with the other participants.

Specifically, the individual teleconferences covered the following topics:

1. Deregulation of Cable and Broadcasting.
2. New Era in Common Carrier.

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3. Spectrum Management: Enough Space?

4. What is the U.S. Role in International Communications?

5. Electronic Information and Publishing.

6. Competition and Ownership in Telecommunications.

7. Future of Public Telecommunications.

8. Legislative Status Report.

The issue addressed in each of the teleconferences seemed to be clothed in an atmosphere of deregulation. Advocating a rewrite of the Communications Act of 1934, examining the consequences of the AT&T breakup, and exploring America's posture in international telecommunications as well as predicting the future in each of the eight policy issues was a fantastic revelation for students and moderators alike.

Merrick Communications, the consultants for the teleconference, furnished the moderator at each site with a packet of suggested readings, an annotated bibliography, possible research topics for participants, and recommendations for tieing various topics together so that individual sessions would become, as it were, the pieces of a telecommunications policy mosaic. Of course, this was only possible because of the advance planning on the part of Merrick Communications and that of the individual moderator at each location who either had a graduate degree in broadcast regulation, a law degree, or, in one instance, that of Nick Johnson, served as a former Federal Communications Commission member.

Moderators and participants agreed that each session of the teleconference would adhere to the following format:

1. WARM-UP

For a 15-minute period prior to the actual teleconference, students at each school would be allowed to ask questions of their moderator. These questions might be in regard to the clarification of unfamiliar cases, or terminology, or why the determiners of telecommunications policy advocated the position they did. Hopefully, the questions that would be asked of the guests in Washington, D.C., would be formulated during this 15-minute period.

2. INTRODUCTION

The actual teleconference would begin by having Christopher Sterling, the Director for the Center for Telecommunications Studies at George Washington University, introduce either two or three guests who served as representative spokespersons for the government or private industry.

3. A STAND ON THE ISSUE

Each speaker was then allowed from three to five minutes to state why he or she took the position on a particular issue and whether they believed that the status quo should be maintained or that a much needed change should be introduced into the political arena.

4. QUESTION AND ANSWER

Next, each of the eight sites would be able to ask a question of one of the speakers. In order to insure fairness, it was decided at the onset that questioning would be done in a round-robin fashion. If an answer needed clarification, then a participant would be allowed a follow-up question. This procedure continued for the next 70 minutes when the teleconference would end with a summation from the host.

5. FOLLOW-UP IN TOLEDO

After the teleconference segment ended, a guest speaker from the Toledo metropolitan area would be invited to elaborate upon the information and viewpoints that had been expressed in the preceeding meeting. Guests who were invited included the legal counsel for the local cable company when the deregulation of cable was discussed. An executive from Ohio Bell was in class to follow-up on the topic of common carriers and more specifically on the break-up of AT&T. Finally, the vice president of the public radio and television station was able to speak about the effects of the budget cutbacks that were being enforced and those that were projected when the future of public telecommunications was the topic of the teleconference. The net result of the segment designated as a follow-up in Toledo provided reinforcement of what was said at the national level.

Favorable feedback from students at the graduate and undergraduate levels was almost immediate. The teleconference sessions made it possible for participants in Oklahoma, Florida, Iowa, Michigan, Alabama, Ohio, and New York to simultaneously hear the comments of governmental officials, industry representatives, and lobbyists from various pressure groups and to question for themselves the reasons why the spokespersons took the position that they did. In essence, students learned how the decisions being made on telecommunications policy would affect them in the future.

The typical classroom setting of lecture and discussion could not have been an adequate substitute for the dynamics of the give-and-take process of teleconferencing. However, that is not to say that there is anything wrong with good traditional classroom teaching, but given the opportunity, why not make the subject matter better by making it as current as possible.

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The success of a course using teleconferencing as its nucleus seems to depend upon two major factors: a dedication on the part of the teacher or moderator to convince participants that this type of electronic meeting can accomplish more effectively and with greater impact the goals of the traditional classroom, and accepting the fact that teleconferencing in one form or another--voice, audio graphic, freeze frame, or full motion--has arrived and is no longer the technology of the future, but is commonly used today in both government and industry settings to promote better communication.

FOOTNOTES

(1) The phrase seemed to be broad enough so that it could include the dynamics of teleconferencing and was used by me during the lecture segment of the seminar Telecommunications Policy, Fall Quarter, 1982.

(2) Lorne A. Parker and Christine Olgren, "CIP Releases New Teleconferencing Study," Telcoms, Vol. V, No. 1. (January, 1982), p. 8.

(3) Greg Paulsen, "The View from VideoNet," Video Systems, Vol. 8, No. 4. (April, 1982), p. 19.

(4) Ibid., p. 20.

Session 3

Providing for Telecommunication Service Requirements in the Local, National and Regional Marketplace

CELLULAR MOBILE TELEPHONY

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1. Abstract

The paper will present the ongoing development in mobile telephony around the world. Examples are given from several countries in North America, Asia and Europe. Specifically the experience from the largest cellular mobile telephone system in operation today will be presented.

2. SUMMARY OF THE CONTENT

The presentation will start with a few examples of earlier mobile telephone systems. The development towards fully automatic cellular systems will be addressed, leading to a survey of the cellular systems in operation today.

Special attention will be given to the Nordic System, covering Sweden, Norway, Denmark and Finland, with more than 65,000 mobile subscribers after 2 years of operation. In this connection some key functions of a cellular system will be presented. The Nordic System gives us experience data about calling habits of mobile telephone users, as well as market data about the demand for mobile telephone service. Diagrams about the Nordic System experience will be presented.

At present the development and construction of mobile telephone systems is taking place in many countries around the Pacific Ocean. Several examples of the way these systems will grow will be given in the paper.

A problem in the mobile telephone field is to find ways for a mobile telephone subscriber to communicate even outside his home area. The development and trend for how to take care of these "roaming" subscribers will be discussed.

The paper will address time schedules and costs for the construction of a cellular mobile telephone system, and will also address the different regulatory environments that are valid in different countries. Finally, development within mobile telephony during the next decade will be addressed.

S.W.I.F.T. Today

Carl Reuterskiold
President
Society for Worldwide Interbank Financial
Telecommunication S.C. (S.W.I.F.T.)
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S.W.I.F.T. is a bank-owned, non-profit cooperative comprised of 1104 shareholding member banks in 54 countries on all five continents as of January 1984. Created in 1973, and operational as a network system since 1977, S.W.I.F.T. operates a specialised worldwide data-processing and telecommunications system enabling member and user banks to transmit and receive standardised, formatted financial transaction instructions among and between themselves with a high degree of reliability and security. In order to meet the rapidly evolving needs of the international banking and financial services community, S.W.I.F.T. is expanding both geographically and functionally to offer member banks and financial institutions the financial data-processing and telecommunications services that financial markets require --as and when they are required.

S.W.I.F.T. TODAY

Good morning ladies and gentlemen. One of the problems we in S.W.I.F.T. have when talking about what S.W.I.F.T. is and what S.W.I.F.T. does is that we are not a banking organisation. Equally, we are not a telecommunications carrier organisation. S.W.I.F.T. does not engage in creating or executing banking transactions, and S.W.I.F.T. does not provide communications transmission facilities.

Rather, S.W.I.F.T. is a cooperative service organisation linking banks around the world through a data-processing and transmission network of a specialised nature. Because of S.W.I.F.T.'s rather unique position between banking and telecommunications, we sometimes have difficulty explaining to outside audiences who we are, what we do, and why we do it.

The key to understanding S.W.I.F.T. is to understand its organisational structure. S.W.I.F.T. is a non-profit cooperative society, created and owned by the member banks that use S.W.I.F.T. services. These shareholding member banks are represented on S.W.I.F.T.'s board of directors. It is essential to understand S.W.I.F.T. and its members are in many ways members of the same family. In consequence, S.W.I.F.T.'s relationship with its "customers" is somewhat special.

The second element is that membership in S.W.I.F.T. is open only to banks and qualified financial institutions located in countries that have been approved as member countries by the Board of Directors. This is not intended to exclude anyone. It simply reflects the basic reality that for a bank in any country to connect to the S.W.I.F.T. system, three conditions must be met.

First, there must be enough banks connected to ensure that the projected traffic volume justifies the expense to S.W.I.F.T. of installing and operating a rather complex computer installation in the new country.

Secondly, these banks must agree to respect the established standards, formats, and procedures common to all the other banks using the S.W.I.F.T. system.

Third, the use of S.W.I.F.T. must be both lawful and technically feasible inside that country. This implies approval by the governmental authorities in matters concerning, for example, exchange controls, approval by the communications carrier of the prospective member country from whom S.W.I.F.T. must lease telecommunications lines and facilities.

With that behind us, I would like to outline S.W.I.F.T.'s history, explaining at the same time the reason for its development.

During the 1960s, the expansion of international banking operations generated an expansion of bank's private networks with each using formats, media, and procedures specific to the network. Only rarely were they compatible, and in no case were they interactive. The result was chaos, or something closely resembling it.

In 1969, a small group of European and North American banks began seeking ways to rationalise their international operations to cope with the ever-rising volume of international transactions.

They wanted a rapid, reliable, standardised, and secure system suitable for the automation of their foreign departments.

By 1973, S.W.I.F.T. was incorporated as a non-profit cooperative and a small permanent staff established headquarters in Brussels, Belgium. The original bank membership comprised 239 banks from what we have come to call the 15 "founder" countries.

By the end of 1974, the system design was complete and after detailed studies, equipment was selected and installed. There followed a period of programming and testing.

Message-text-standards were developed through the efforts of international working groups of experts. Initial system standards covered clean payments, foreign exchange confirmations, deposits and statements for nostro reconciliation.

Finally, live system operation began on the 3rd of May 1977, and by September 1977 S.W.I.F.T. completed the first phase of its development with 439 banks from the 15 founder countries using the system.

Reduced to the simplist terms, S.W.I.F.T. is a specialised communications system. It is designed to receive, transmit, and deliver financial instructions among its member banks. Behind every S.W.I.F.T. "message" is a financial transaction of some kind. Member banks agree that a properly verified instruction delivered by S.W.I.F.T. is a valid financial order. Before S.W.I.F.T., such an order might have taken the form of an international bank transfer on a piece of paper. Using S.W.I.F.T., it takes the form of a computer printout.

You can easily imagine that such an instruction requires a higher level of control and verification than an ordinary telephone call or telex message.

It is because of this requirement for control, authenticity, and privacy that a specialised system was, and is, necessary. All the more because S.W.I.F.T. assumes financial liability for the banking instructions passing through the system.

Today, S.W.I.F.T. has passed its tenth anniversary. In the ten years since its foundation, and in the six years that S.W.I.F.T. has been an operational system, we have accomplished a great deal. Nevertheless, I think it is remarkable that until recently, S.W.I.F.T. has spoken of itself mainly in terms of its history rather than in terms of its future.

The international banking and financial community now has an industrywide interbank transaction processing system capable of processing and transmitting a wide variety of transactions among and between member banks with unprecedented speed, accuracy, and security.

S.W.I.F.T. has become indispensable to the smooth functioning of the payments departments of most large internationally active banks as well as providing major operational advantages to smaller or more specialised banks.

However, recent developments have taken S.W.I.F.T. beyond the strict limits of the bank payments department and new service possibilities are being developed.

Since 1977, S.W.I.F.T. membership has expanded to exceed 1100 member banks from 55 countries, and each year new member countries make progress toward fulfilling the promise of the word "worldwide" in the Society's name. Today the whole of Western Europe, much of the Americas, and a substantial part of the Asia/Pacific Basin is either operational, or in the process of becoming operational on the S.W.I.F.T. system.

Equally, a start has been made in extending S.W.I.F.T. service into Eastern Europe with Czechoslovakia and Hungary, and in Africa with South Africa, Morocco, and Tunisia.

S.W.I.F.T. service expansion into Latin America has also continued at a lively pace with Argentina, Chile, Ecuador, Mexico, and Uruguay in live service, and Brazil, Colombia, Panama, Peru, and Venezuela preparing for implementation of live service.

We have also started extending S.W.I.F.T. service into the Middle East and Africa with the connection of South Afica and Israel, and Morocco and Tunisia preparing to implement live service.

However, of particular interest to you are S.W.I.F.T. plans in the Asia/Pacific region. Currently S.W.I.F.T. serves member and user banks in Australia and New Zealand, Japan, Hong Kong, and Singapore. Recent member include Thailand, the Philippines, Taiwan, Korea, and China. These members are all presently involved in the preparatory phases prior to the implementation of "live" system service, each according to their own priorities and pace.

Current planning has Taiwan, the Philippines, and China implementing live system service in 1984, and Thailand, Korea, and India in 1985.

However, there is more to S.W.I.F.T. than simple geographic coverage. There is now increasing emphasis on functional expansion.

Between 1977 and 1980, S.W.I.F.T. service covered customer transfers, bank transfers, foreign exchange and loan/deposit transactions, statements and confirmations of debits and credits, and a variety of S.W.I.F.T. system messages and reports.

In 1981, S.W.I.F.T. added documentary collections, and interbank securities transactions. In 1982, we added a number of special payment mechanisms including the processing of international authorisations for Mastercard transactions. Just two months ago, S.W.I.F.T began processing a major new transaction sector with documentary credit transactions which should have a substantial impact in areas such as the Pacific Basin where transoceanic trade is a major fact of economic life.

Documentary credits is a major new service sector for S.W.I.F.T. and we expect that it will bring major benefits for S.W.I.F.T. member and user banks in terms of speed, accuracy, flexibility, and service to banks and bank customers.

To a telecommunications audience, the point to stress is that S.W.I.F.T. should be considered as another element of an emerging group of telecommunications-based systems dedicated to specialised needs rather than general communications needs.

TERMINALS

A major concern of S.W.I.F.T. as a service system is the integration of the terminal sector with various telecommunications networks. Progress is being made in developing industrywide standards for telecommunications services, most notibly through the development of the ISO open systems architecture.

Within the financial services sector, S.W.I.F.T and the banks see a real need to more closely integrate the bank terminal operations with the requirements of various interbank operations such as CHIPS, CHAPS, automated clearing houses (ACH's) and certain bank proprietary systems such as VISA. EUROCHEQUE/EUROCARD, MASTERCARD, and possibly independent payment systems such as AMERICAN EXPRESS and others. Neither S.W.I.F.T. nor the banks operate in a vacuum. The banks, S.W.I.F.T., and these other systems must find effective and appropriate ways of integrating their operations to meet total bank operations requirements.

In S.W.I.F.T.'s view, the place to integrate these various systems and services is where the bank connects to them -- at the bank terminal. This is another major opportunity for the banks, the system services, and the telecommunications community to work together for the mutual benefit of all concerned.

S.W.I.F.T.'s involvement in terminal interfaces dates almost from the beginning of the Society in 1973. As preparations advanced for cutting over to "live" operations, a number of member banks expressed concern that the new standards and procedures would require a specialised terminal incorporating rather complex specialised software needing updating on a regular basis. It looked like a somewhat expensive exercise for the banks and they wanted access to a common set of software and appropriate equipment. S.W.I.F.T. adopted a cooperative approach to solving that problem and contracted with three computer equipment manufacturers for a suitable machine available in a number of configurations. The objective was to ensure the availability of suitable terminal equipment and software at a better price based on a uniform market definition, ease of operation, and adaquate traffic capacity. These terminals were called SID's (S.W.I.F.T. Interface Devices). The equipment was supplied and installed by the manufacturers, software was, and is, supplied and updated by S.W.I.F.T.

SID was the ideal solution for the bank with a centralised DP structure, but many banks have a decentralised DP structure and operate in many regions of the world with varying traffic volumes. To meet the needs of the decentralised banks -- which are becoming more numerous -- S.W.I.F.T. undertook the development of an independent, stand-alone, small capacity terminal system in 1980. Of course, by this time there were a variety of stand-alone terminal systems available from a wide variety of manufacturers, as well as a selection of software packages from different firms able to work on different hardware used by different banks.

The reason for the S.W.I.F.T. involvement can be briefly summarised as the bank's need for a "total system" comprising both hardware and software and software support as part of an overall package. Hardware manufacturers were understandably reluctant to undertake long-term software committments for what was a rather specialised and limited market -S.W.I.F.T. operational banks. Naturally, software firms were willing to provide the desired software, but the adaptations required to run the software on a wide variety of different machines promised to be quite costly. S.W.I.F.T. reached the conclusion that a total package was the best response both operationally and economically and contracted with a major manufacturer for a modified version of a suitable machine.

Another major motivating factor is that S.W.I.F.T.'s revenues are directly related to the traffic volumes sent on the system. The best way to ensure the maximum use of S.W.I.F.T. is to ensure that the member banks have access to easy-to-use and economical interface systems.

S.W.I.F.T.-supported interfaces also maximise the use of S.W.I.F.T. standards and are suited to the more rapid introduction of new message types and transaction processing applications. Easy-to-use interface systems also simplify the connection of new member and user banks and distant branches thereby reducing implementation and support costs for both S.W.I.F.T. and the member banks concerned. Finally, through cooperation with major computer equipment manufacturers, S.W.I.F.T. is able to offer member banks very advanced packages at minimum software cost as well as passing the benefit of S.W.I.F.T.'s experience and research directly to member and user banks.

The first S.W.I.F.T. supplied and supported terminal interface system was the ST100 providing the ideal stand-alone terminal system for a very modest price. S.W.I.F.T. member and user banks boughtr over 750 of these systems in the first 18 months of its availability, and it is now in service worldwide as the ideal terminal system for small to medium volume banks, branches, as well as for backup.

The next S.W.I.F.T. terminal system was the ST200, an expandable multi-terminal system. The ST200 can be configured with up to nine workstations, each with its own microprocessor and with access to a central processing unit enabling the system to concurrently handle different applications and to link with a bank mainframe.

Finally S.W.I.F.T. addressed the needs of the high-volume bank running applications in a mainframe environment. The ST500 is a high-speed "gateway" or "front end" system capable of handling all S.W.I.F.T. protocols and frees the bank mainframe from S.W.I.F.T. interface functions while simultaneously enabling the S.W.I.F.T. interface to operate independently off-line during the hours when the mainframe may be out of service. The ST500 is available in single or double CPU configurations with optional magnetic tape stations.

S.W.I.F.T. has also addressed the rapidly growing requirement for communications security for data traffic moving between the bank terminal to the S.W.I.F.T. regional processor. Within the S.W.I.F.T. environment itself, data is protected by multi-level encryption techniques. However, the security of the traffic between the bank terminal and the S.W.I.F.T. regional processor is the bank's area of responsibility. With the advent of the "personal computer" and the spread of technological knowledge and equipment, the security of this link is increasingly threatened. Until recently the cost of sophisticated encryption equipment necessary to protect this link was substantially higher than the risks warranted. However, today the risks have grown rapidly, and S.W.I.F.T. has developed the STEN encryption device which has cut the cost of hogh-level encryption protection dramatically.

SECURITY

One of the primary objectives of S.W.I.F.T. is to ensure the highest possible standard of security for the transations processed through the S.W.I.F.T. system. Because of S.W.I.F.T.'s superior standards of security, S.W.I.F.T. is able to assume financial liability for the accuracy, completeness, and timely delivery of validated transaction instructions from the moment they leave the sending bank's circuits to the moment they enter the receiving bank's circuits.

The overall environment of S.W.I.F.T. security is composed of a multi-level combination of physical security, line security, operations security, and procedural security. All transactions entering the system are validated to ensure that they originate from an authorised terminal, that they meet mandatory format and message-text-standards, and that they are addressed to a valid S.W.I.F.T. recipient.

All transactions moving within the S.W.I.F.T. system are continuously encrypted, and stored copies (for eventual retrieval) are kept in encrypted form. The only thing S.W.I.F.T. may know about the content of any transaction is the name and address of the sending bank, the receiving bank, and the general type and priority of the message. Instructions entered into the system that fail validations, protocol, and format tests are rejected.

Stored transactions may be decrypted only upon the written demand of either the sending or recipient bank.

S.W.I.F.T. can thus accept financial liability, within stated limits, that the delivered instruction is both complete and identical with the input message. Member banks, however, are required to use an authentication procedure that forms part of the security chain.

CONCLUSION

All of you in this audience know about the rapid growth of communications and computers. I hope you now know more about how S.W.I.F.T. fits into today's banking and service industry.

I want to stress in conclusion that telecommunications today is a very complex variety of services. A leading international banker recently addressed a large seminar that S.W.I.F.T. sponsors and said that, "The communications infrastructure is today the nervous system for the financial service industry and for society as a whole."

If this is true, and I tend to agree that it is, we in the telecommunications industries have a fundamental duty to work together to ensure that our world benefits from the advanced, economic, high-performance telecommunications techniques available today, and tomorrow.

PTC'84 Luncheon Address

Notes

Prospects for the Pacific Basin : The Changing Business Environment

J.H. Stevens
Chairman, Canada Wire and Cable, Limited
International President, PBEC

It is a pleasure to discuss with you today prospects for the Pacific Economies. Our concern, in PBEC, is how the changing business environment is altering commercial and financial opportunities in the region. Thus, my remarks today deal less on the quantitative aspects of a particular regional forecast and more with the factors and forces that will shape growth during the remainder of this decade

Let me begin by making three broad observations. First, the Pacific Basin will remain, comparatively, the best global region for trade, investment, and growth during the next ten years. The growth rates of the Pacific economies will be, however, below those of the "Golden Era" of the 1960s and 1970s.

Second, the resiliency of the economies of the Pacific to the oil shocks and 1979/1983 recession has been remarkable. This performance demonstrates the flexibility of the private sectors and governments within the region in coping with abrupt change. It also reflects the strategic value of the capital stocks and human skills which were developed over the past two decades. These relatively new resources successfully confronted substantial economic stress.

Third, planning for Pacific business operations should no longer be based on the nearly uniform growth experience of the 1960s and 1970s. Much greater diversity in country performance related to specific market and product expansion will emerge over the next five-to-eight years.

The Global Setting for Assessing Pacific Prospects

The Pacific Community, large though it is, represents only one portion of the world community. The Pacific Basin's Economic affairs are inextricably linked to the economic, political and social developments in the rest of the world. While the recovery from the 1979/1983 recession is underway, serious questions remain about the fundamental "health" of the world economy.

In a background paper for the May, 1983, Williamsburg Economic Summit, John Curtis, Director, International Economics Program, The Institute for Research on Public Policy which is located in Ottawa, noted the following. I quote:

> The international economic system, with its institutions, policies and practices as we have known them since 1944, is adrift and slowly unwinding. It is not about to collapse, and indeed has reacted relatively well, through a variety of ad hoc measures and mechanisms, to the many structural and cyclical changes of the 1970s and early 1980s. But its decline (however one decides to measure it), is clear. Unquote.

There are three major classes of problems that must be addressed if the economic decline is to be reversed. These problems must be addressed in the light of massive unemployment in the EEC, in the U.S., and in other countries. Unresolved unemployment conditions produce political pressure for shortsighted, selfish protectionist measures. Let me discuss each class or problem briefly.

The first major class of problems includes those associated with the essential stability of the international economic system. Our primary concern is how to sustain a broadly based recovery. There are several important requirements:

a. Reduction of interest rates is a key factor. Not only would this lead to direct improvement in the investment climate and the stimulation of constructive capital spending, but it would make the solution of other problems easier;

b. Better coordination of monetary and fiscal policies is also critical; and,

c. Improved intergovernmental coordination of economic policy is necessary.

Our next concern is how to improve international debt management and liquidity:

a. The immediate problems are liquidity levels and confidence that international debts can be managed on a country-by-country basis through governments, central banks and private commercial banks. To this end the IMF and the International Bank for Reconstruction and Development (World Bank) will have to be given resources that are adequate and available quickly enough to assure that trade will not be reduced even further; and,

b. International debt problems lead to currency devaluations and consequent uncertainty faced by the private sector. This in turn leads to reduced investment, lower growth, and less trade.

The second major class of problems that must be addressed, if the economic decline is to be reversed, includes those factors which have been exerting a continuing downward pressure on global and regional economic performance. Among them are protectionism in trade and in investment, and the impact on trade flows of wide fluctuations in exchange rates.

Protectionism results from political, social and economic pressures and is manifest particularly in the advanced industrialized countries. It is the cumulative effect of protectionism practiced by a significant number of countries that exerts downward pressure on international economic activity.

The GATT negotiating process produced positive results while economic activity in the world was expanding. This process is being severely strained under present conditions and does not offer much promise for combating protectionism in the short term.

What is needed is the development of practical and realistic action programs aimed at the systematic reduction of all trade barriers, especially nontariff barriers. These programs must recognize the employment and social impact of related adjustments in both developed and developing countries. Unrealistic results must not be expected.

It must also be understood that, as a directly related issue, export subsidies and preferential financing can be destructive in nature.

While the flexible exchange rate system may have helped the world economy to adjust to the economic and oil shocks of the 1970s, and the early 1980s, it has created other problems. International operations are severely inhibited by the uncertainties in pricing and settlement. A better exchange rate system must be developed to reduce these problems.

Finally, three significant factors are influencing the long term development of improved economic performance. These factors must also be addressed if economic performance is to be improved.

The first factor is the erosion of investment and productivity in economies such as that of the United States. This has contributed to reduced growth rates. Growth rates in the late 1980s and early 1990s may be only two thirds of those in the "Golden Era" of the 1960s and early 1970s.

This shift to lower rates of growth in large, advanced economies, increases the importance of developing more effective patterns of government-to-government policy coordination and consultation. The broadening of market access and the encouragement of appropriate investment must become a priority for governments.

The second factor is the enormous shift in economic activity, in the last twenty years, from industrialized countries to newly industrialized and less developed countries. This shift in location of many manufacturing industries, such as textiles, electronics and automobiles, has had an important impact on employment in the industrialized countries and on the investment of capital as well as on regional trade flows. Thus, the nature of regional economic interdependence has changed dramatically over the past decade. The Pacific region can no longer be viewed in terms of simple linkages between developed and developing countries. The phenomenon of interdependence is now more complex and it continues to change as the NICs and the LDCs adjust their economic strategies.

A third factor is the rapid development of technology and the rate at which it is being utilized in various regions of the world. Most of these developments are high in cost. Some countries, particularly the smaller ones, and those that do not have access to large markets, may be at a disadvantage. This factor must be taken into account in the equitable resolution of economic problems.

I have described an economic environment resulting from factors that have produced a world economic system with serious short term problems. In the PBEC-Paper published last year on the Pacific Economic Community Concept, I made the point that today, and for the foreseeable future, if the potential of the Pacific Basin is to be realized, the private sector must interact with governments to alter the stategic business environment.

We must, therefore, seek to improve our understanding of the three major classes of problems contributing to the systemic downward decline in economic activity, as well as our understanding of their interactions. We must also improve our ability to formulate realistic short-term programs for change consistent with desired long-term goals.

The Emerging Pacific Business Environment

Strategic Factors

A variety of factors and trends will influence the evolution of the Pacific Basin's strategic business environment over the next decade. Let me now discuss some of these factors.

First, performance of the U.S. economy sets a "cap" on Pacific growth. The United States is the largest export market for Canada, Japan, Korea, Hong Kong, the Philippines, Taiwan, and New Zealand. It represents the second largest market for Thailand, Indonesia, Singapore, and Australia. While U.S. imports from the Pacific have fallen during the past decade, for over 50 percent of the annual inflow of goods and services to about 40 percent, this decline in large part reflects the shift in the proportion of imports represented by OPEC oil.

There are major uncertainties as to the status of the restructuring of the U.S. economy currently underway. Clearly jobs in the auto industry, steel and other basic "smokestack" industries are not going to be recreated just because of a minor upturn in the business cycle. These are classic examples of structural unemployment that is only solved through personal, private sector or government retraining programs.

Much has been said of late about the shift to service industries. Indeed, the percentage of GNP represented by services has risen dramatically over the past two decades. A healthy U.S. economy, however, must maintain an appropriate balance between the services and manufacturing sectors.

If the first factor in determination of trade and investment relations in the Pacific is the performance of the U.S. economy, the second is the degree to which Japan will internationalize its economy during the decade. Problems with Japanese trade surpluses with most Pacific countries, as well as in other global regions, are well documented.

Several factors bear on the assessment of Japan's impact on Pacific economic growth. The first is the reduction of impediments to trade, both in the tariff and nontariff barriers that limit current penetration of Japanese markets. The second involves steps that should be taken to further liberalize financial markets. And the third is the concept or "model" that the Japanese might accept as their long-term goal for internationalization.

The several earlier Japanese trade opening packages were greeted with some skepticism by western business executives. Many of the changes announced were cosmetic in nature and represented little real change in the problems encountered by foreign business firms operating in Japan.

Since Nakasone has become Prime Minister there has been a more substantial commitment to the reduction of tariffs and nontariff barriers. Much remains to be done. Many markets are still severely limited due to nontariff barriers including trade and industrial policies associated with the "Japanese way of doing business." The last group of legal changes recommended for diet consideration represents a modest beginning in the removal of factors that limit the ability of foreign business executives to expand significantly their exports to or operations in Japan.

Another condition for Japan's participation as a major player in the international economic system is the further internationalization of its financial markets. The most recent series of changes began with the late 1980 revisions to the Foreign Currency Control Act. Several administrative reforms have followed. The Japanese financial services sector is still characterized by slow change in an era when the international financial services area is increasingly dynamic in developing new products and institutional arrangements.

The last factor involves the concept or "model" the Japanese might use to guide long-term policy and it is of major strategic importance to the region. The internal debate centers on doing business as usual--after all the current strategy has been very successful--or opening the economy further to direct foreign influence.

In the eyes of some western economic specialists, the current dispute between the industrialized nations and Japan is not really about trade, but about economic development and technological progress. This view has some validity, and it merits consideration in any assessment of how much the current trade and investment barriers will be reduced and by what process.

Another strategic factor conditioning the prospects for growth in the Pacific Basin will be the development of new growth strategies for the newly industrialized countries. What has brought Korea, Taiwan, Hong Kong, and Singapore to where they are today, will not necessarily take them where they want to be at the end of the next ten years. The plentiful supply of low-cost labor has essentially disappeared. Traditional industries are now feeling competition from the advanced developing nations as they progress up their own ladders of development. As the NICs increase the technological content of their export products, they have begun to affect markets in the advanced industrialized countries, with predictable protectionist responses. Finally, domestic political factors have increased as modifiers of policy and policy implementation.

Important differences among the high growth, newly industrialized countries are now emerging in self-perception, objectives, and economic strategies. These differences can be expected to become more evident with each passing year.

An additional factor conditioning continued high level growth in the Pacific is the expansion of market access for the NICs and developing countries of the region. Protectionist actions are increasing as the growth of the world economy slows and political actions impede the necessary adjustment process.

A key concern of the developing countries in their relations with advanced nations is the renewal of the generalized system of preferences (GSP) by which products of the developing countries and the NICs gain preferential access to the markets of the industrialized nations. The U.S. has been taking a harder line on the GSP of late. Other advanced countries seem to be willing to follow the U.S. lead in this policy area.

The issues of market access and the GSP are reflections of the broader dialogue about relations between the NICs, with their demonstrated international competitiveness in many product areas, and the advanced industrialized countries, whose markets, because of their size, represent opportunities essential to continued stable, high levels of growth. This "testing" and sorting out of proper relationships will continue throughout the 1980s.

Another factor influencing the evolution of Pacific economic relations is the increasing tendency to address domestic economic and political problems through protectionist measures. This is a global problem as well as a regional one. The recent failure of the GATT ministerial last fall is but one visible indication of how serious the problem has become. Practical ways need to be identified to hold the line against protectionist pressures and to put each of our own houses in order. These forces are strong and will exert downward pressure on regional growth by limiting the flow of trade and investment among Pacific countries.

The final factor is one that will emerge as a more visible force in shaping Pacific economic affairs in the latter half of the 1980s. It is the orderly development of trade in food and food products. The difficulties that lie ahead in responding to fundamental changes in the production of food products for international trade have been overshadowed by and kept hidden from view by the energy crisis.

As the smaller countries of the Pacific improve their economic well-being, it is reasonable to expect that they will also increase their per capita demand for food products, such as meat and convenience goods. Initially this increase should not be a problem, as the food production capacity of the United States and several other countries is well developed and excess capacity exists. Later in the decade however, the limited ability to add new land to the production base and expand productivity will become more evident.

Other issues and problems will also play a role in shaping the economic prospects of the Pacific nations:

First, the emergence of the People's Republic of China as an active trading nation will provide many opportunities. This country's volume of trade rose from $US14.7 billion in 1977 to nearly $US41 billion in 1982;

Second, a need exists to develop more high value added products for export to balance trade deficits in the oil-importing, resource poor nations;

Third, the development of energy and mineral resources will also be an important factor pacing growth;

Finally, the Pacific region has been the location of two major wars since 1950 and numerous, continuing border conflicts. In spite of this, economic prosperity has led to general political stability in the area. Can this continue? The answer seems to be yes, although changes in political leadership, some of them perhaps abrupt, in several Pacific countries are possible during the next several years.

Alternative Planning Scenarios for the Pacific Basin

PBEC has been examining three scenarios for Pacific Basin economic prospects. The scenarios encompass the uncertainties associated with the strategic factors influencing the evolution of the Pacific business environment. The scenarios are:

- The Pacific era is at hand;
- Increased stress and widening of growth differentials; and,
- Stop-go growth.

The first scenario is based upon the perception that the strong performance of the past decade will be matched over the next ten years. In this case, after a gradual recovery from current recessionary conditions, the region would see a sustained continuation of high levels of growth and manageable levels of inflation. Interdependence will continue to increase, as trade expands above world averages.

The controlling assumptions for this scenario include:

- The U.S. solves, in large part, its productivity and investment problems; inflation remains under control; the dollar drifts to more realistic levels; interest rates fluctuate but long-term rates fall to levels consistent with growth stimulation.
- Japan becomes significantly more international; domestic sources of growth increase significantly; trade frictions subside.
- The NICs solve their transition problems to new growth strategies.
- The confidence in long-term growth prospects contributes to the orderly development of mineral and energy resources.

The second scenario, increased stress and widening of growth differentials, reflects the differing abilities of the Pacific economies to cope with the political and economic problems they face. The economic problems would not be just cyclical and associated with the 1979-1983 recession, but would be systemic. Some countries would be more successful than others in controlling inflation and unemployment. As a result, the differences in economic performance among countries would widen. Interdependence would increase slightly over the last decade but protectionist pressure would rise.

The controlling assumptions for this scenario include:

- Some countries continue their exceptional growth performance; others encounter difficulty in coping with economic problems.
- As some countries outperform others, investment and technology transfer flows favor them, increasing the growth differentials of the developing countries and NICs.
- The U.S. solves some of its productivity and investment problems but does not achieve sustained high growth during the next decade.
- Japan's internationalization proceeds at a sluggish pace but there is acceptance of the commitment to trade liberalization by her trading partners.
- The growth experiences of the NICs become mixed. Several are successful in shifting to higher value added exports while maintaining necessary levels of domestic employment. Others encounter problems and experience diminished economic performance as exports decline or do not expand to meet economic targets.

The third scenario, stop-go growth, could result from any number of major disruptions. It could result from a mid-east energy embargo or failure of the orderly flow between supplier and consumer countries of other resources in the region. It could also result from a series of political crises. The pattern that would emerge is one in which the current stability of economic interdependence would give way and the Pacific economies would become more competitive entities than at present. Protectionist pressures would increase significantly, especially the use of nontariff barriers.

The controlling assumptions for this scenario are more difficult to specify, although several characteristics seem likely:

- The U.S. would probably continue to experience problems of stagflation.
- Japan's ability to expand domestic demand would be limited and tension would increase in her major export markets.
- The NICs would scale down growth plans; inflation would increase as an economic problem.

- Developing countries would find it increasingly difficult to reduce current levels of debt and expand exports.

An informal survey of executives active in Pacific operations indicates the following distribution of views regarding the alternative planning scenarios. The "Pacific Era is at Hand" scenario was favored by 10% of the executives. The second scenario, "Increased Stress and Widening Growth Differentials," was the most probable expectation of Pacific prospects, being favored by 65% of those surveyed. Only 25% of the executives thought the "Stop-Go" growth scenario accurately described the prospects of the regional economies over the next decade. Recent developments have reinforced the likelihood of the "Increased Stress and Widening of Growth Differentials" scenario.

Prospects

All business executives and economic specialists are aware of the impressive performance of the Pacific economies over the past decade or two. A useful recap of this experience was published in the September, 1982 issue of Euromoney.

Based on a composite index of five leading indicators, the second through the eighth coutries in terms of performance were all from the Basin. Singapore, the country with the second best performance for the period 1974 to 1982, led the Basin's economies, followed by Hong Kong, Taiwan, Malaysia, Korea and Thailand.

Japan placed 14th on the list of 81 countries. The United States was 27th and Canada 40th, with New Zealand 52nd. Other rankings based on inflation or balance of payments for the same nine-year period were also generally favorable to the Pacific economies. The concern today is whether or not the growth experience of the past can be sustained.

Wharton Econometric Forecasting Associates recently published the results of a long-term forecast of the world economy (see Table 1). The high growth of the "Golden Era" is clearly evident when one reviews their forecast. The world economy grew at about 5.5 percent annually from 1960 to 1973. Developed countries grew at around 5.0 percent, while the growth of the OECD high performer, Japan, was nearly 10 percent per year for the same fourteen year period.

The oil shocks and stagflation of the 1973 to 1983 period lowered growth significantly. World economic development grew only 2.6 percent a year during the past ten years, and the advanced countries only 2.1 percent. The relationships of basic factors of production began to change, and the sources of growth that had carried the high growth rates began to decline.

We now find ourselves in a period of so-called sluggish recovery, a condition which is likely to characterize the period from 1983 to 1988. What is significant, however, is that the period from 1988 to the mid-1990s is likely to see growth rates no greater than those of the sluggish recovery period, and perhaps even slightly lower. But what of the prospects for the Pacific economies over the rest of the 1980's?

A recent SRI International forecast for the region indicates a recovery for all Pacific economies during 1984 and 1985 (see Table 2). The developed economies of the United States and Japan, will, therefore, represent increased export opportunities for the developing countries. The NICs will move back toward their historical high growth rates. The resource exporting nations of Australia and Canada are expected to rebound as the demand for their commodities increase.

More specifically, the U.S. is likely to experience continued expansion leading to a 1984 growth rate of about 5 percent. Japan will expand at around 3.5 percent during 1984 and 1985. The Canadian and Australian economies will probably expand at rates near 3 percent next year and above 3 percent in 1985. The ASEAN economies will all grow at rates above 4 percent, with the exception of the Philippines which may only expand at about 3 percent. Inflation in most Pacific countries should continue to moderate, as a positive after effect of the recent worldwide recession. Higher than desired levels of unemployment, however, will continue to limit the initiatives available to domestic economic policymakers.

Some Characteristics of the Emerging Pacific Business Environment

There will be many interesting and important issues needing further examination if we are correct in depicting the next decade as one that is characterized by the phrase "increased stress and widening growth differentials".

While the growth prospects are bright for the Pacific economies, some will be brighter than others. It will be necessary to examine, on a country basis, whether or not the telecommunication industry will flourish best in association with strongly performing economies, or will represent a solid growth industry even

Table 1

GROWTH OF REAL GDP
(Annual Average Compound Growth Rates)

	GOLDEN ERA 1960-1973*	OIL SHOCKS AND STAGFLATION 1973-1983*	CYCLICAL RECOVERY 1983-1988*	PROJECTED GROWTH 1988-1992**
World	5.5	2.6	2.9	3.1
Developed Countries	5.0	2.1	2.6	2.8
U.S.	4.1	1.9	3.3	3.4
Japan	9.9	3.4	3.4	3.6
Europe	4.8	1.8	1.7	2.2
Developing	NA	NA	3.5	3.3
Oil-Exporting	8.2	1.6	NA	NA
Oil-Importing	5.5	4.3	NA	NA
Centrally Planned Economies	7.2	4.0	3.3	3.0
Latin America	NA	NA	2.9	2.8
Pacific Basin	NA	NA	5.4	5.8

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* Source: Wharton Economic Forecasting Associates
** Source: SRI International

Table 2

GROWTH OF REAL GROSS DOMESTIC PRODUCT*
(Percent)

	1984	1985	1986	1987	1988	1989
Australia	3.5	3.6	2.9	2.4	2.6	2.9
Canada	3.3	3.5	2.8	2.6	2.4	2.9
Japan	4.6	4.7	3.9	3.2	4.0	4.2
United States	4.5	4.6	3.8	3.2	3.4	3.4
New Zealand	2.0	2.3	2.1	1.4	1.9	2.0
Hong Kong	4.2	4.8	4.8	4.5	4.5	4.7
Korea	7.5	7.7	7.5	7.0	7.3	7.5
Taiwan	6.0	6.5	6.6	6.3	6.6	6.9
Singapore	6.7	6.9	6.6	6.9	7.0	7.2
Indonesia	3.5	4.0	5.1	4.6	4.8	5.1
Malaysia	5.1	5.4	5.5	5.3	5.5	5.9
Philippines	3.3	3.2	4.3	3.8	3.6	4.1
Thailand	5.8	6.1	5.9	5.5	5.3	5.9

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* Source: SRI International (11/83) Constant Prices, 1975$U.S.

in those Pacific economies that slip slightly in aggregate performance.

Let me comment briefly on several characteristics of the emerging business environment that have implications for the telecommunications industry.

First, most countries will increase their international orientation because of the increasing importance of exports and foreign investment. This implies increased international communication and, given the prospects for the Pacific economies, even greater growth in the Pacific.

Second, the awareness of the Pacific Basin as an increasingly interdependent region will grow in both the business and cultural communities. This heightened awareness should contribute to increased inter-regional activity and hence increased communication.

Numerous new institutions are being established to improve awareness and understanding of political, economic, cultural and other aspects of Pacific affairs. For example, in Canada we have recently established an Asia Pacific Foundation that will fund studies and convene conferences to expand our understanding of Canada's interests in the Pacific, and of the practical opportunities facing government policymakers and business executives. Another example is the evolution of the Pacific Economic Community Concept which has attracted wide attention. This will undoubtedly lead to an increase in the accumulation and interchange of data and of the means for access to it. Such activity will stimulate telecommunication development.

Third, services in general can be expected to increase as a share of GNP in most Pacific economies, the increase in service industries is, in part, a reflection of the changing nature of industry management. Moreover more leisure time will lead to more travel and tourism. These factors will undoubtedly result in greater demand for telecommunication services.

Fourth, as Pacific commerce expands, it is expected that various kinds of industrial cooperation will increase, by industrial cooperation I mean joint ventures of all kinds--research and development, production, advanced technology and resource development. As the various forms of industrial cooperation expand, an increase in telecommunication services will follow.

Finally, during the next decade the impact on business of the information revolution will become clearer. There is no question that better use of information systems will improve business operations. This is already receiving greater recognition and is another factor favoring telecommunication growth.

The foregoing brief analysis of the characteristics of the emerging business environment is ample evidence of the increasing demand for strong development of telecommunications in the Pacific.

Concluding Observations

Let me review the main issues and conclusions:

- Assessment of Pacific prospects must be made within a global context. The Pacific, given its growth potential, has a special role to play in the reversal of the global economic decline. To achieve this objective, the private sector must become more active in the solution of the problems contributing to the systemic slowdown of economic activity.

- The Pacific Rim is still the most economically promising global area, although the growth prospects in the region are less optimistic than those of the last two decades.

- The economies of the developed countries are in transition. The U.S. is mid-way through a major re-structuring process. Japan is coping with the nature of its international economic and political role. The growth opportunities of all Pacific economies will largely depend upon how these two issues are resolved.

- The NICs are viewed as the dynamic force in shaping Pacific opportunities, Korea, Taiwan, Hong Kong and Singapore are all presently addressing major changes to their economic strategies.

- Finally, the prospects for the Pacific economies and the expected changes in the nature of interdependence with the region indicate increased opportunities for the telecommunications industry. The shift from a monolithic growth experience to one of greater diversity, and the changing nature of regional economic interdependence, will require a more sophisticated assessment of the opportunities than in the past.

- I believe that the telecommunications industry faces a formidable challenge. I am sure that it will rise to the occasion and provide the information facilities necessary for the rapid development of the region. This will present tremendous opportunities for entrepreneurial businesses in the telecommunications field.

Concurrent Working Groups

Notes

Group 15 Resource Paper

Photo Voltaic Systems as Prime Power in Communications Installations

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Although the Photo Voltaic (PV) effect was discovered over 140 years ago extensive practical use had to await the advent of the spaceage. Today, in addition to space applications, PV systems are widely employed as power for lighting, water pumping and communications installations. To date, over 80% of all applications have been remote communications sites.

SOLAR ENERGY

The sun is a nuclear power plant which generates power in the form of radiant energy at the phenomonally high rate of 3.8×10^{23} kilowatts. An extremely small fraction of this (less than a billionth) is intercepted by the earth, but this small fraction amounts to a huge 1.8×10^{14} kW. On the average, about 60% of this amount penetrates the atmosphere to reach the earth's surface (1.1×10^{14} kW). Of course, this amount of power is distributed over the entire surface of the earth. To bring these numbers closer to home, consider that on a bright sunny day each square meter of surface facing the sun receives about one kilowatt.

To compare these numbers with our energy needs, consider that the present electrical generating capacity in the U.S. is in the neighborhood of 5×10^{8} kW (consumption is about half of this). This is equivalent to the average sunshine falling on only 1000 square miles. Even if we could only utilize 10% of the incident sunlight, a single square plot of land only 100 miles on a side would provide the same electrical power as the present U.S. generating capacity. Clearly, there is more than sufficient energy available from the sun to meet present and future needs if we could learn to utilize it economically.

SOLAR CELLS

Direct conversion of solar energy can occur in two ways. The incident sunlight can be converted directly into heat by photothermal conversion, using a device which selectively absorbs the suns rays. A greenhouse is a crude form of this device. The incident sunlight can also be converted directly into electricity by photovoltaic conversion, using a device called a solar cell which utilizes the photoelectronic properties of a semiconductor. It is this device which is the basis for the business of Solar Power Corporation. Solar Power Corporation manufactures solar cells, constructs multicell modules, forms these into arrays, and designs complete systems to meet customers' needs. These systems are marketed worldwide. At today's costs, these markets are mostly remote power applications such as microwave repeater stations, off-shore navigational aids, railroad grade crossing signals, and other applications that require reliable electrical power in locations not readily accessible to personnel or commercial power lines.

Basically a solar cell is a large area semiconductor diode, so constructed that light can penetrate into the region of the diode p-n junction. Silicon is used almost exclusively today as the semiconductor in commercially available solar cells. Certain impurities deliberately introduced into the silicon give rise to excess negative or positive charges which can carry electric current in the silicon. For example, phosphorous atoms give up electrons to the silicon to form n-type silicon (excess negative charges) while boron atoms soak up electrons from the silicon leaving holes (missing electrons) which behave like excess positive charges (p-type silicon). A p-n junction can be formed close to one surface by allowing boron to diffuse into the surface of an n-type single crystal wafer at high temperatures. The p-n junction formed between the n-type silicon wafer and the p-type surface layer provides the electric fields which give rise to the diode characteristics as well as the photovoltaic effect. Light is absorbed in the silicon by generating both excess holes and electrons (one hole-electron pair for each photon absorbed). If this occurs near the p-n junction, the electric fields present there will act to separate the holes from the electrons, causing the holes to build up in the p-type material and the electrons in the n-type material. By connecting wires to the n and p-type regions these excess charges, generated by the light and separated by the junction, can be made to flow through an external circuit to provide power to an external load.

Each cell can supply current at voltages up to one-half volt. At lower voltages the current supplied is nearly independent of voltage, but varies with light intensity. About 160 mA can be obtained from each square inch of surface exposed to bright sunlight. This would amount to over 2.0

amps from a 4 inch diameter cell. The maximum power deliverable to an external load is typically 11% to 15% of the total solar energy incident on the cell (over 15% has been demonstrated in laboratory models). To obtain higher voltages, cells are connected in series; higher currents are obtained by connecting cells in parallel. Such connections are made when cells are packaged in modules. The modules then become the building blocks for arrays designed to meet specific needs of customers.

In order for the solar cell to work as described, the silicon surface must be accessible to the incident light. Therefore the exposed surface cannot be covered with a metal conductor. However, metal contact to the surface is needed to pick up the current, so at least part of the surface must be covered. The trick is to cover as little of the surface as possible while providing sufficient current-carrying capacity and widespread distribution of pickup points over the surface to avoid any significant power dissipation in the contacts. For this reason the contact is put down in the form of a grid.

ENERGY STORAGE

The total energy received from the sun in one year at any specific location on the earth is amazingly constant. The variation from year to year is less than 10%. However, within one year large variations occur both seasonally and daily, much of which is unpredictable. To avoid power outages at night and during inclement weather, some means of storing the energy generated on sunny days must be employed. Many photovoltaic generator systems in use today employ rechargeable electric storage batteries for this purpose. Therefore, standard solar cell modules are designed to provide the correct output voltage to efficiently charge these batteries. The solar generator array is designed to provide all the energy required by the load over the year. The storage battery acts as a buffer between the solar array and the load, supplying power to the load during periods of low sunlight (and no sun) and accepting charge from the array during periods of high sunlight. Therefore, its state of charge may vary seasonally as well as daily; the average sunshine during the winter may be insufficient to supply the load, but this insufficiency will be made up by an excess of sunshine during the summer.

The capacity of the storage battery must be chosen to meet these demands. The storage battery also serves conveniently to fix the voltage at which the system will operate.

SOLAR GENERATOR SYSTEMS

In addition to a properly sized solar cell array and storage battery, a complete solar electric generator system will include a blocking diode to prevent battery current drain through the solar cell array at night. In complete darkness, the solar array is simply a string of diodes which would be forward biased by the storage battery. The blocking diode between the solar array and battery allows current to flow from the array to the battery, but not from the battery to the array.

A voltage regulator may also be included in a complete system to avoid overcharging the battery, which results in a loss of electrolyte. This will occur when the battery is fully charged, but the solar array is still supplying more power than the load demands.

A voltage regulator may not be essential for systems which are not expected to supply a large excess of energy over the year or if the customer is willing to visit the site occasionally to replace lost electrolyte. However, a voltage regulator is recommended for all systems which are expected to produce over 20% excess energy over the year.

It is common to describe the size of solar photovoltaic systems in terms of their peak power output; i.e., the maximum power that can be delivered to a matched load when the incident sunlight is $100mW/cm^2$. However, by itself, this is not a significant parameter in the design of a solar array battery charging system. Both the current and the voltage characteristics of the solar array must be considered in conjunction with the battery voltage characteristics to obtain a proper match between the two. This means that the power must be supplied to the battery at a high enough voltage to fully charge the battery. For a typical 12-volt lead-acid battery, this voltage can range up to slightly over 14 volts.

The current level obtained from a module of series-connected cells, is the same as that obtainable from a single cell in the module; this in turn, is determined by the exposed surface area of the cell. To obtain lower current levels the module would have to be built with smaller diameter cells. Higher current levels can be obtained either by using larger cells, if they are available, or by connecting modules in parallel. In the latter case, the total current obtained is the sum of the current from the individual modules. This does not change the voltages at which the current drops off, which is fixed by the number of cells in series in each module.

Different battery voltages are accommodated by connecting modules in series. If one module is properly sized in voltage for a 12-volt storage battery, then two such modules in series would be properly sized for a 24-volt battery. Thus, a specific application may require modules to be connected both in series and in parallel: series-connected to match the specific battery voltage, and additional modules connected in parallel to provide the required current generating capacity.

The constant charging current nature of a solar cell array properly matched to the storage battery allows system sizing to be computed in terms of ampere hours. This is very convenient because this quantity is very nearly conserved in a storage battery. Ampere hours out almost equals ampere hours in, even though power out is less than power in (amps come out at a lower voltage than they go in). In addition, the current supplied by the solar array is directly proportional to the incident sunlight.

MODULE DESIGN

Mechanical considerations play a large role in module design. SPC modules are designed to operate in ambient temperatures ranging from -40° to +90° Celsius. They can withstand humidity from 0 to 100% and altitude of up to 25,000 feet (7,620 meters). They are designed to withstand winds in excess of 175 miles per hour (280 kph).

Wind loading values are a direct measure of a module's structural strength and resistance to vandalism and should be carefully considered.

In most applications, weather conditions are such that cell temperatures will rarely exceed about 60°C, and modules are designed for these normal applications. However, applications are occasionally encountered where climatic conditions lead to cell temperatures reaching 65 to 70°C. For example, in low altitude tropical locations, ambient temperatures may reach 40 to 45°C in season. Under these high temperature conditions, the cell temperatures will exceed ambient by 20 to 25°C, and derating of modules should be taken into account when sizing systems. Usually the result will not affect the system design because this derating occurs at the time of the year when the battery has been brought to full charge by the excess sunlight. Therefore, there is no justification to design a special module with one or two extra cells in series for these special applications.

SPC modules have met and/or exceeded the test requirements of the U.S. Dept. of Energy Jet Propulsion Laboratory (JPL) document 5101-65. The rigorous JPL tests qualify modules for inclusion in federal procurement programs. In addition to the JPL tests, SPC modules have been subjected to and successfully passed weatherometer, accelerated ultraviolet, sand blasting and military standard salt/fog tests.

One particular problem in module design is thermal cycling, or large, regular shifts in temperature. In a desert, for instance, temperatures can become very hot in the day and then very cold at night. The various components of a module (such as the cell, the encapsulant and the metal frame) expand and contract with such changes in temperature.

The problem for the module designer is to have the components expand and contract in a coordinated fashion, so that they will not crack, rub or become detached from one another. If a module requires hermetic sealing, the problem is compounded. Regular expansion and contraction can impose considerable loads that, if poorly designed or fabricated, render the edge seal of the module useless.

When the edge seal of a module becomes detached, due to diurnal thermal cycling, hermetic sealing is lost; the module encapsulant is then exposed to the atmosphere. It thus becomes imperative to choose an encapsulating compound that will resist deterioration when exposed to the elements.

The use of Ethylene Vinyl Acetate (EVA) as a photovoltaic module encapsulant has clearly shown its inherent advantages over all other materials. It is highly stable in the harshest environments, is unaffected by intense UV radiation and has amassed an outstanding field performance record.

Additionally, as a final protection to preclude the need for hermetic sealing, all internal components (cells, busbars, interconnects, etc.) should be highly corrosion resistant.

Modules have an estimated service life of 15 to 20 years, contain no moving parts, require little if any maintenance and, of course, no fuel or connection to any electrical grid.

BATTERY SYSTEM DESIGN

The major factors influencing the selection of storage batteries for use with solar panels are: battery type required, voltage, ampere-hour capacity and the environment in which it will be operating.

The two most common types of batteries used in solar electric generator systems are lead-acid and nickel-cadmium. The choice of battery type is usually specified by the customer. It is important in the case of lead-acid batteries to use low self-discharge types. For lead-calcium or pure lead grid constructions, losses are generally 1% of rated capacity per month. Lead-calcium types are preferred due to their higher mechanical strength. Lead-antimony grid types are not suggested since initial self discharge is 7 to 8% of rated capacity per month, and as the battery ages this figure rises to as much as 30 to 40% of capacity per month. Self-discharge loss becomes a load to the solar array and will increase the size of the solar panel without providing any power benefits to the user.

Battery capacity must be specified for the environmental conditions to which the battery will be exposed. Batteries are normally rated for operation at normal temperatures (between 0 and 30°C). When the battery cannot be insulated from abnormally cold temperatures (e.g., -20 to -40°C) by burial or placement in an insulated enclosure, it is necessary to derate its capacity. It cannot be allowed to discharge to the point where the electrolyte will freeze.

One other factor influencing the selection of a battery is its charging efficiency. Up until the battery reaches 90% of full capacity, the solar panel charges the battery essentially in a constant current fashion. Therefore, the solar panel designer need only be concerned with ampere-hour charging efficiency of the battery. This efficiency is typically 95% acceptance or greater at normal temperatures. The bulk of the charging inefficiency manifests itself in the form of voltage level. The battery requires a higher voltage to accept a certain number of ampere-hours than it provides when the same ampere hour capacity is drawn off.

As the battery reaches and exceeds 90% of capacity the solar array current decreases rapidly with increasing voltage. If the solar panel voltage (i.e., number of cells in series) and current outputs have been carefully matched to the load, this will provide a self regulating mechanism. However, when the solar array outputs exceed the load requirements by more than 20%, an external voltage regulator may be required to avoid excessive overcharging of the battery. This situation can arise because of the incremental changes in array output when modules are added to the array.

Batteries used with solar electric generator systems frequently operate under conditions which favor electrolyte stratification: the battery bank is stationary, and charging and discharging currents are low (typically less than 1% of battery capacity per hour). Under such conditions, it may be desirable to allow occasional mild gassing of the electrolyte to provide for mixing.

Nickel-cadmium batteries exhibit low self-discharge losses, and are more tolerant of accidents than are lead-acid batteries. For example, they will fully recover from freezing (the electrolyte becomes slushy) and from complete discharge to zero volts. Excessive overcharging will not damage the battery, but of course, the water lost from the electrolyte must be replaced. These advantages are often offset by high cost, voltage inefficiency (charging voltage 15% higher than discharging voltage, compared to a 5% change for lead acid batteries), and lower voltage per cell resulting in more cells to obtain a given battery voltage then lead-acid systems.

ROUND TABLE DISCUSSION

NOTES

ELECTRONIC DEMOCRACY: GLOBAL AND NATIONAL CONTEXTS

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Abstract

This paper* reviews the global and national contexts of the impact of the new information technologies on participatory democracy. The essay argues that information technologies have historically acted both as catalysts and impediments to democratic participation. Their role should be therefore understood in the context of the institutional packages in which they come and the linkages they establish with the democratic forces at the national and local levels. Three global metatrends and three national models of communication and democracy are identified here that set the pace and constraints of democratization around the world. The processes of transnationalization of the world economy, tribalization of world politics and democratization of world cultures provide the global context, while the three competing/complementary liberal democratic, communist democratic and communalist democratic models of communication and democracy shape the national environments. Demands for direct vis-a-vis representative and corporatist forms of democratic participation have combined with the new technological possibilities for interactive communication to facilitate new experiments in participatory democracy.

> "I am certain that in 300 years historians will say that in our times we were attempting to accommodate democracies as they have evolved with the old direct democracy of Athens. Pericles could speak directly to the people of Athens: a phenomenon that disappeared for over 2000 years is finally coming back."
>
> --Andre Malraux

Information technologies have historically served both as catalysts for as well as impediments to democratic participation. The advent of print gave rise to the democratization of knowledge, weakening of the traditional sources of authority (the church and the monarchies) and the creation of a new secular priesthood--the modern intelligentsia--who fought for the freedom of speech, assembly and association as well as for the equality of opportunity and fraternity among the dispossessed. The mass circulation press extended the cultural and educational benefits of the print media to the literate citizens. The electronic media have done the same for the millions of the illiterates throughout the world. The globalization and miniaturization of the new information technologies, symbolized by the convergence of the satellite and the chip, are creating immense further opportunities and services for interactive modes of communication in ways still unfolding.

On the other hand, however, information technologies have also served historically the centers of power and privilege in a variety of different ways, to legitimate their interests, mobilize resources on their behalf, and manipulate citizens and consumers for their own ends. Modern bureaucracies would have been inconceivable without modern information technologies. Modern wars could not have been fought without modern information technologies. The modern bureaucratic state and corporation as the two most dominant centralizing forces in the modern world could not have emerged without an extensive development of information technologies. In fact, most modern information technologies owe their origins and development to their military uses. The use of broadcasting as well as point-to-point telecommunications were initially advanced by the military needs for fast, efficient and reliable methods of message dispatch. Civilian uses were largely a by-product.

The newly emerging information technologies are also establishing both highly centralized networks and vastly decentralized nodes in complex and interactive systems. Although we are just at the beginning of our understanding of their potential revolutionary effects, the debate on their implications has already taken on a polemical character. The proponents of "information society" tend to suggest the dawning of an era of interactive communication and democratic participation, while its opponents see in the new information technologies the potential for greater individual surveillance, political manipulation and cultural domination. Contrary to this polemics, however, this chapter will argue that information technologies, like all technologies, are on the whole amoral and apolitical entities. There are clearly some exceptions to this general rule; the technology of chemical warfare has few other applications. But most technologies can be used equally for good as well as ill intentions. They also entail some intended as well as many unintended consequences. In the institutional packages/arrangements with which they come, technologies serve the explicit purposes for which they have been designed. Concurrently, however, they also serve many unintended consequences in combination with social, economic, political and cultural forces present in their environment. For an understanding of their role, therefore, we must turn to an examination of the historical contexts in which they play a part.

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*This paper is Chapter I of a forthcoming UNESCO monograph on Electronic Democracy: Access, Participation and Community Media.

This chapter will therefore focus on the global and national environments of the new information technologies. It will provide an analysis of the global context in which the processes of democratization are taking place, while offering a conceptual framework for the understanding of the variety of national contexts in which the new information technologies might promote access, participation and community media. This theoretical discussion will hopefully prepare us better for an understanding of the empirical findings on problems of access, participation and telecommunity that will follow in the subsequent chapters.

THE GLOBAL CONTEXT: COMMUNICATIONS AND DEMOCRATIZATION

Our own era may be characterized by the dominance of three concurrent and contradictory/complementary global metatrends. (1) For want of any better terminology, we may call these trends, the processes of *transnationalization* of world economy, *tribalization* of world politics and *democratization* of world culture. All three trends seem to owe a good measure of their global force and pervasiveness to the impact of the new information technologies. But they also correspond to the worldwide historical processes of modernization/industrialization, characterized by increasing levels of *accumulation* (defined here as increasing concentrations of wealth, power and information), *mobilization* (increasing claims for wealth, power and information), and *dis/integration* (the cultural lags or leads that reconcile the conflicting pressures of accumulation and mobilization and characterize the evolutionary/revolutionary processes of matching our belief systems to our institutional structures). The dialectics of this global process of development seems to stand at the root of our contemporary crises of democracy and international communication. (2) (For a schematic view of these historical transitions, see Table 1).

The accelerating processes of transnationalization of the world economy have been engineered in the postwar period primarily by the transnational corporations (TNCs) whose growth and prosperity vitally depend on an expanding world trade and development, an integrated world market, and rapid and efficient transportation/telecommunications infrastructures (Barnett & Muller, 1974; Wallerstein, 1979; Amin, 1974; Brock, 1981). The processes of transnationalization have already achieved high levels of vertical and horizontal market integration, reasonably flexible world monetary and fiscal systems for necessary adjustments, and a world technocratic/managerial elite with common ties of education, values and interests.

However, the present international political system, organized principally around the sovereignty of the nation-states, appears to be a historical anachronism when compared to the rationality, efficiency and dynamism of the transnational entities. There is thus a growing disjunction between the world economic and political systems. The transnational corporations have operated on the basis of corporate autonomy, stockholder accountability, and tendencies towards concentration and world economic integration, while the nation-states presume national sovereignty and have proliferated from 51 UN member states in 1945 to 157 in 1983. With the increasing world technological and economic integration, as exemplified by the increasing global integrated services digital network (ISDN), direct broadcasting satellite (DBS), transborder data flows and increasing transnational patterns of ownership and management, we may anticipate greater frictions between the world techno-economic and political systems.

The current world trade and monetary inbalances and their ensuing protectionist trends are symptomatic of the problem (Rohatyn, 1983). Given the increasing patterns of world interdependence, however, protectionism is a solution worse than the problem. The world thus faces a political/cultural lag in its techno-economic development that will intensify in the coming decades. The central focus of these problems will be, as the Brandt (1980) and MacBride (1980) reports have amply demonstrated, the conflicts between the transnational rights of free trade and free flow of information and the sovereign rights of protectionism, cultural autonomy and balanced *cum* controlled information flows. In short, the transnational corporations have led the postwar world towards a dynamic but lop-sided pattern of growth that is fast reaching its political and economic limits.

Whereas transnationalization trends represent a top-to-bottom process of accumulation and concentration of wealth, power and information, a reverse bottom-to-top process of mobilization of the world peripheries against the centers is also currently at work undermining the world system created at Bretton Woods. We may label this as a process of "tribalization" in that it represents a reaction against the universal and secular scientific-technological culture of transnationalization, while calling for a return to smaller and more cohesive communities. The slogans of "small is beautiful," "self-reliant development," "appropriate and soft technology," "less is more," and "neither East nor West" are reminiscent of these sentiments and trends in a variety of socio-historical conditions (Schumacher, 1973, 1977; Freire, 1972; Illich, 1971a&b, 1973, 1974, 1978). But the emotional intensity and political force of such sentiments can be best witnessed in the new fundamentalist or neo-traditionalist movements. The Islamic neo-traditionalist movement in Iran and elsewhere, the Solidarity movement in Poland backed by the Catholic church, the new Theology of Liberation in Latin America, the Moral Majority in the United States, and the Jewish fundamentalist movement in Israel, though disparate in political and moral objectives, seem to spring from the same sense of alienation and yearning for community caused by the dehumanizing effects of modern technocratic structures. (3) The breakup of some states such as Lebanon, the civil wars in some others such as Northern Ireland and South Africa and the increasing ethnic consciousness and tensions in most other parts of the world, including such bastions of democratic pluralism as the United States and Britain, are also suggestive of the tribalization of politics on a world scale.

The *civic* identities imposed by the great abstractions of nationalism, and the *status* identities implied by notions of national sovereignty, class solidarity or professional loyalty, are increasingly rejected in favor of the far more potent communal bonds of *primordial* identities represented by common language, ethnicity or religion. As the repository of the most cherished historical memories, culture has thus become the last ditch defense of the common man/woman against the stupendous and complex socio-technical forces reducing him/her to conditions of abstraction and anonymity. In its most blatant forms, the politicization of culture in some movements (such as the Cultural Revolution in China or the Islamic revolutionary movement in Iran) threaten also to destroy the very traditions of civility that had served to mitigate the conditions of social injustice and political repression in society.

However, the technocratic achievements of the new transnational political economy have proved to be also its chief sources of weakness and vulnerability. Complex technologies, such as the new transportation, telecommunications and warfare systems, and complex organizations, such as the modern bureaucratic machinery of the state and transnational corporations, have proved themselves to be all too vulnerable when confronted with the challenges of dedicated mass movements or small group activists. The defeat of the United States war machinery in Vietnam when confronted with the resistance of an indigenous revolutionary movement and its own domestic peace movement, the fall of the Shah's massive military and civilian bureaucracies in Iran in the hands of spontaneous civil demonstrations employing telephones and audio-cassettes as their methods of political terror and propaganda, and the numerous terrorist penetrations of the most impenetrable sanctuaries are suggestive of what might become epidemic in the years to come. Violence and non-cooperation have thus served as the mode of communication of the world's oppressed and disenfranchized to a complex, incomprehensible, insensitive but vulnerable techno-economic world. (4)

So much for the bad news! There seems to be, however, a concurrent worldwide process of democratization also at work that is gradually but painfully building the future institutional fabric of our Spaceship Earth. The driving spirit of this movement is perhaps best captured in the slogan of "Think Globally, Act Locally!" (Feather, 1980). The movement is largely based on human association by "affinity" rather than "vicinity," bringing people together on the basis of their common material/ideological interests rather than proximity (Galtung, 1980). A new tribe of people committed to the Universal Declaration of Human Rights and its extensions into the social, economic and cultural spheres is spearheading this movement. The new information technologies are facilitating such global networks, but their linkage into existing and emerging voluntary, non-governmental and non-corporate associations (the NGOs) is providing powerful channels for the discussion of common issues and problems facing mankind. The ecology movement, the Club of Rome, the Nuclear Freeze Movement, Amnesty International and the numerous other religious, civic and scientific associations are only some of the best-known examples of such global networks cutting across national or corporate interests and boundaries. To the extent that such associations are alert to the emerging human needs, problems and prospects, we may entertain a cautious optimism on the resolution of some of the manifold contradictions of transnationalization and tribalization.

The foregoing states the problematic of the role of information and communication in global development in its broadest possible terms. If this statement lands anywhere near the mark, we might pose a number of related questions that have to be entertained. What has been historically the role of information and communications technologies in international development? Are we at the dawn of a new evolutionary Age of Information that promises new breakthroughs in the application of advanced science and technology to the age old problems of world poverty, inequality, ignorance and prejudice? Does the increasing abundance of information and computer networking mean also increasing levels of *data* (relevant information), *knowledge* (informed opinions), *wisdom* (historically stored and retrievable insights), and *sound decisions* (an informed will to act)? Or, conversely, is the explosion in the sources and varieties of information leading to information glut and overload, future shock, and intellectual confusion (Toffler, 1970, 1981)? Are the technological and socio-economic advances of the information age creating greater information equality or information gaps and dualisms between the information poor and information rich? Does the phenomenal growth in channel capacity, brought about by the introduction of cable television, computerized videotexts and direct satellite broadcasting, imply greater political freedom and participation, cultural pluralism and enrichment or centralization, political surveillance, cultural domination and impoverishment (Schiller, 1969, 1976, 1981; Mattleart, 1979; McPhail, 1981; Tunstall, 1977; Woodward, 1980; Pool, 1983)? Are the accelerating processes of automation, implied by the application of robotics and computer-assisted design and manufacturing (CAD-CAM), leading to greater leisure and cultural creativity or increasing levels of unemployment and a perennial problem of technologically by-passed excess population? Has the worldwide expansion of global communications networks effectively undermined the national sovereignty and cultural autonomy of the smaller and weaker states? Or, conversely, are we at the dawn of a new world community encapsulated into a global village (Nordenstreng & Schiller, 1979; McLuhan, 1964, 1968)? Can we assume that the worldwide extension of the new technologies will lead to the diffusion of a universal, modern, scientific civilization or a cultural backlash against the onslaught of modernization?

THE NATIONAL CONTEXT:
MODELS OF COMMUNICATION AND DEMOCRACY

Few of the above questions can be clearly answered, if at all, on a global basis. Given the enormous disparities in the economic, political and cultural conditions of different countries, the national context would thus provide a more manageable level of analysis. However, as we have argued, national systems of communication are increasingly tied to and powerfully influenced by the global trends. An understanding of the linkages of the two systems is thus critical to an understanding of the role of information technologies in the processes of democratization.

These linkages can be best understood perhaps by focusing on the three competing/complementary models of communication and democracy that seem to have gained worldwide acceptance: the liberal democratic, the communist democratic and the communalist democratic models generally prevalent in the so-called first, second and third worlds of development. Each of these models has emerged out of different sets of historical conditions that imply radically different conceptions of democracy, but their total impact reveals an evolutionary development of the concept. Here, we shall briefly discuss the main features of each model in theory and practice and suggest the challenges and opportunities they each face with respect to the new technological and social developments in the field of information and communication.

The Liberal Democratic Model

The liberal democratic models of communication and democracy developed first in the historical context of Western capitalism but have now been exported to all parts of the world. They are based on the fundamental concepts of popular sovereignty, universal rights of suffrage, representation through elections, checks and balances through a separation of executive, legislative and judiciary powers, a bill of rights to guarantee individual and collective rights to speech, assembly and political action, and by extension the development of voluntary associations and the Fourth Estate (the Media) to watchdog the elected or appointed officials, to shape public opinion and to bring pressure on government on behalf of special interest groups.

The theory and practice of liberal democratic models have, however, been subverted by a number of historical developments, including concentrations of economic and political power, bureaucratic power without representation, tyrannies of the majorities, and mind management and manipulation through mass media propaganda. The inherent tendency of capitalist growth towards economic concentration is a well-established historical fact. This tendency towards the development of Big Business has been to some extent checked by the development of countervailing powers in Big Government, Big Labor Unions and Big Media (Galbraith, 1956). However, all four institutional structures are in fact expressions of the same general trend in modern industrial societies towards concentrations of economic and political power in the hands of technostructures (fused technologies and bureaucracies) that represent no one in particular but themselves (Galbraith, 1978). These structures have become increasingly divorced from their original constituencies (the stockholders, the general electorate, the labor union members, and the mass media audiences), self-perpetuating and often democratically irresponsible (Murdock, 1982).

The first two subversions of democracy emanate from above, while the last two originate from below. Tyranny of the majority seems to be an inherent weakness of democratic societies recognized long ago by de Tocqueville (1835-40). Ever since his farsighted predictions, the world has witnessed several different mass movements in the forms of Fascism, Nazism and McCarthyism prevailing in the Western democracies at least for a period of time. The historic conditions which gave rise to these movements (economic depression, the rise of radical movements from the left, and an alliance of the propertied classes with the lower middle classes to exploit class interests and status anxieties in hysterical anti-communist and anti-Semitic mass movements) are still with us. So are the threats of a recurrence of mass movements that might sacrifice individual liberty at the altar of social equality or national identity.

The Communist Democratic Model

Communist democracies have presented to the world a second model of communication and democracy.

Although the principles of representation are still maintained, the theory of socialist democracy goes beyond simple representation to focus on problems of social inequality. The solution orthodox Marxism has offered to this problem consists of two stages, i.e. the dictatorship of the proletariat as a transitional stage to the final stage of the withering away of the state. In practice, however, the socialist democracies have shown themselves no less vulnerable to the technocratic pressures than the capitalist democracies. The state has not withered away, and the dictatorship of the proletariat has taken the shape of dictatorship of the Party led by an elite within it and, under Stalinist circumstances, a system of terror controlled by one strongman. The "iron law of oligarchy" (Michels, 1966) has been thus at work in the socialist parties no less than in the large capitalist corporation. The Party leaders like the corporate managers have often succeeded in seizing power away from their constituencies (i.e. the workers and the stockholders) to exercise it without much responsibility. Communication under these models of socialism has been dubbed as "democratic centralism," in which the center issues the commands after a period of free discussion within the Party cadres. But in practice, the parameters of freedom are increasingly narrowed as the party organization comes progressively under the command of a privileged elite and eventually one leader.

A variety of different attempts have been made in the communist democracies to correct the rigidities inherent in such a system, considered to be inimical not only to political democracy (freedom) but also to social democracy (equality) and cultural democracy (fraternity). The de-Stalinization reforms following the 20th Congress of the Soviet Communist Party opened the door to a number of other reforms in the rest of the Soviet camp. Outside of the Soviet camp, however, even more daring attempts have been made to guard against concentrations of power. The Yugoslav model of market socialism and self-management and the Chinese Cultural Revolution suggest two such efforts with diametrically opposite purposes and consequences. Following the uprising of 1956, the Hungarian political reforms and economic liberalization seem to have also produced some progressive results attracting the attention of the rest of the Soviet camp (*The Economist*, 1983a). The postwar development of Eastern European socialist democracies has brought them, however, increasingly into the orbit of world transnational forces. Their dependence on the major sources of world technology and capital has opened them up to pressures that are now universal in scope. We have discussed some of these pressures in the preceding section; we will now focus specifically on the pressures for direct democracy that are present in capitalist, socialist as well as third world democracies.

The Communalist Democratic Model

In contrast to the liberal democratic and communist democratic models that stress liberty and equality, respectively, the communalist models of communication and democracy tend to underscore the primacy of fraternity and community. The social and psychological dislocations of industrial society in both the first and the second worlds and their devastating effects in the third world in the form of colonial and neo-colonial domination, have led to the emergence of a variety of neo-traditionalist movements, from the United States to Poland to Iran, that insistently demand direct community participation in decision-making. The common ethos of these movements consists of a sceptical attitude towards all authority, whether representative or corporate, an emphasis on cultural democracy (identity and ethnicity) and a desire for the assertion of the community will in matters of social concern.

There is thus a linkage between the counter-cultural movements in the first and second worlds and the counter-modernization, communalist trends in the third world. That linkage can be perhaps best understood in terms of the concepts of direct democracy. Western ideals of democracy have been shaped to a large extent by the Greek ideals of direct democracy. In the Age of Pericles, the citizens of Athens (excluding the slaves and women!) participated directly in the discussion and resolution of public issues. Our modern democracies have fallen short of that ideal on at least three counts. First, modern democracies are at best representative democracies. The views and interests of citizens are thus mediated and inevitably distorted through representation. Secondly, however, as modern industrial society grows more and more complex, the ordinary citizens are further removed from the decision-making processes affecting their fate by technostructures that are neither representative nor responsible. The increasing concentration of economic and political power in the hands of the modern private corporations and state bureaucracies and their techno-managerial elites is an almost universal phenomenon. Thirdly, the Fourth Estate and the voluntary associations which in democratic theory were supposed to check and balance the power of the other three branches of the government as well as of the private corporations, have themselves fallen victim to the same technostructural forces which they were supposed to correct. Communication in modern industrial societies is *mediated* communication, the reality discussed is a manufactured reality, and the public opinion polls obtained are manipulated and interpreted by a techno-managerial communication elite responsible only to its corporate or state bosses.

Is there no hope therefore for democracy? Some of the current technological and social developments fortunately seem to suggest some grounds for cautious optimism. For the first time in 2000 years following the Athenian experiment, direct democracy seems to have become a viable alternative to representative and corporate models of democracy. Certain conditions would have to be met, however, beforehand. (5) First, in direct democracy, small size is of the essence. The bigger the size of a political community, the greater would be the need for representation and the higher the level of distortion and manipulation of the electoral process. That is why citizens often feel more politically efficacious at the local than at the regional or national levels (Margolis, 1979). Secondly, public office should be considered more as a public trust than as a social privilege. No frills for the office holders would therefore go a long way towards attracting people with greater commitments to public service than personal gain. Third and equally as important, the principle and practice of rotation of public offices should be radically redesigned to guarantee that no professional class of self-perpetuating politicians are made possible. Periodic, mandatory rotation of office holding will result not only in more responsible and responsive office holders but also in a more experienced pool of citizens. Fourth, the right to information and communication should be considered as an inalienable right with a minimum degree of necessary constraints to protect the equally important rights of privacy and collective security (Margolis, 1979).

The technological and institutional requirements for direct democracy are in part already with us and in part a problem of generating the appropriate political consciousness and will to create the right institutions. The global integrated system digital network (ISDN) has already begun to make it possible to switch ordinary citizens into interactive systems of communication carrying voice, data, text and images. One such experiment in Britain dubbed as "Project Universe," undertaken jointly between industry, government and universities, is among the world's first attempts to meet the challenge (*The Economist*, 1983b). It will tie into one global telecommunications network six local ones, a total of over 150 computers of different types. The technology is therefore available, but it will take considerable economic and political resources to put it to the right uses.

To insure citizen participation, two conditions must be met. The services must be universally made available and the price should be affordable. On both counts, the performance of the telecommunications industries has been encouraging. The rapid growth of these industries has been on the whole counterinflationary. Since 1965, the price index of INTELSAT unit service charge has dropped from 100 to 5, while cost of living has risen beyond 250 (Pelton, 1982). Developments in fiber optics and optical rather than electronic computing promise further cuts in costs, greater speed in transmission, breakthroughs in robotics and higher artificial intelligence and more universal availability (*The Economist*, 1983c).

Obstacles to direct democracy do not seem to be therefore so much technological as institutional (Wicklein, 1981). Nevertheless, there is some room for cautious optimism on this score as well. There are now some political movements afoot around the world that have made direct democracy their cause. The most notable of these showing some political success at the polls is, of course, the Green Party in Germany. In March 1983 parliamentary elections, the Greens won 5.6% of the vote and 27 seats. Although critical of representative democracy, the voice of the Greens in the German parliament will be against politics as usual and for nuclear freeze, devolution of power from central to local government, and rejuvenation of democracy by rotation of their own office holders and direct citizen participation (Galtung, lecture notes, 1983). The political ethos of the Greens has been in the air since the counter-cultural movements of the sixties, but its transformation into political movements with a political philosophy and program for the transformation of our democratic institutions is a relatively new development. The strength of the ideals they espouse can be perhaps best gauged not so much by the proportion of votes they have received as by the espousal of those ideals in the rhetorics of the more well-established parties. A nuclear freeze resolution, for example, just passed the U.S. House of Representatives in 1983. The devolution of power from federal to state governments has been part of the campaign rhetorics of the Republican Party in the United States.

However, in the Third World where most models of communication and democracy have been adopted from the industrial world, demands for direct democracy have taken another shape. The psychological wounds of colonialism have combined with the pressing needs for grass-roots mobilization to underscore the primacy of fraternity and community vis-a-vis liberty and equality. President Julius Nyerre's call for *ujama* in the development of Tanzanian society, the prominence of the concept of an Islamic *umma* in the neo-traditionalist movements of the Islamic world, Pauolo Friere's central preoccupation with "conscienczation" in the process of self-awakening of the oppressed, are all suggestive of the same fundamental trends of thought and social action for a revitalization of community and communal rights and responsibilities.

CONCLUSION

This chapter has examined the global and national contexts of the current technological revolution in information and communication. We have argued that information technologies in the past as well as in the likely future have had contradictory effects on the processes of democratization. They have, on the one hand, led to a broadening and deepening of public participation in the processes of decision making at the local, national and international levels. But on the other hand, they have also facilitated a level of concentration of information, power and decision making within complex techno-bureaucratic organizations (notably the modern state and corporation) unprecedented in human history. In view of the perennial problems of cultural lag, however, we may anticipate that the short-run effects of the present technological revolution in information management will lead to further concentrations of power, privilege and dualism between the information rich and information poor.

Nevertheless, we have also identified in this chapter some global and national trends that suggest both concentrations and dispersions of power. The transnationalization of the world economy is undermined by the tribalization of world politics, while the processes of world integration are developing the networks of world interdependence in global voluntary associations that transcend national boundaries and parochial economic interests. At the national level, also, the processes of democratization are reaching the local levels of power where demands for direct community participation are beginning to break through the institutional rigidities imposed by representative and corporate models of communication and democracy. The new abundance of channels, accessibility in price and quantity, and interactivity in modes of communication, made possible by the new information technologies, promise unprecedented levels of access, participation and community media experimentation. The next chapter will focus on the origins, development, problems and prospects of these new participatory experiments in telecommunity.

TABLE 1. COMMUNICATIONS AND GLOBAL DEVELOPMENT; MEGATRENDS AND TRANSITIONS

TRANSITIONS: *CARRIERS/ MEGATRENDS:*	*SOCIO-ECONOMIC: from pre-industrial/ rural to industrial/ urban economies*	*POLITICAL: from authoritarian to participatory polities*	*CULTURAL: from oral to multi-media com.systems*
ACCUMMULATION/ TRANSNATIONALIZATION	*Growth of urban population and urban infrastructures; construction of a physical infra-structrure, i.e. transport, power, education, telecom; capital accumulation in primary, secondary and tertiary sectors.*	*Construction of a modern bureaucratic state, including the military, administrative and legal structures.*	*Construction of modern cultural, scientific and educational infrastructures, including multi-media chanells of communication.*
MOBILIZATION/ TRIBALIZATION	*Development of autonomous urban social and political structures and institutions providing a countervailing power to the state; land reform and freedom of factors of production from traditional institutional fetters.*	*Increassing levels of social class and ethnic consciousness and demands for equality and participation.*	*Increassing levels of cultural consciousness of the oppressed and minorities demanding recognition and autonomy.*
INTEGRATION/ DEMOCRATIZATION	*Integration of urban/rural settlements into a national pattern of equitable interdependency; creation of an integrated national market*	*Creation of efficacious institutions of political participation to allocate values (resources and ideas) authoritatively,*	*Development of a universal cultural value system reconciling the particularisic values with over-all national goals and objectives, emerging out of a community of global interets, authorities and identities.*

NOTES

1. Although there is considerable overlap between the three trends suggested here and the ten "megatrends" outlined by John Naisbitt (1982), the two underlying views of the situation differ fundamentally. Naisbitt presents a generally perceptive but over-optimistic "American" view, popularizing the theories of post-industrial information society rather uncritically. This book takes issue with such evolutionary and linear views of history, suggesting the picture is far more bleak when we measure the promise of modern information technologies against their performance in the present context of North-South inequalities and East-West misperceptions. The concept of "metatrends" also suggests that the three contradictory trends, referred to here, transcend whatever parochial validity Naisbitt's megatrends might have. For a critique of Naisbitt's views and methods, see Joffe, 1983.

2. Throughout this monograph, the term "communication" will be used in the singular whenever we are referring to the act or processes of human communication, and in the plural whenever we are pointing to the ensemble of information technologies (mass media, point-to-point telecommunications, computer networking, etc.) or to the science of communications studies (as in economics or mathematics, etc.). Clearly, mass communication(s) may be considered a contradiction in terms in so far as it tends to be one-way and uninteractive.

3. Naisbitt (1982) refers to this phenomenon by the psychological category of "high tech, high touch," but the implications of the phenomenon go clearly well beyond the personal psyche.

4. Following the assassination of Senator Aquino in August 1983, we may be also witnessing the rise of another mass movement of civil disobedience against the dominant technostructure in the Philipines.

5. I am grateful to Johan Galtung for some of the points discussed below, lecture notes, Conference of the World Future Studies Federation, University of Hawaii at Manoa, March 1983.

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The Impact of Communication Technology on Daily Social Activity

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I. Introduction

A. Rationale. Why a study on impact of communication technology on social activity?

B. General overview of communication technology's impact on culture and social activity

C. Research findings on the development of communication technology and their impact on Filipino social structure

D. Assumptions on the role of selected communication technology on social life

II. A Research Design -- A Case Study on the Impact of Communication Technology on Daily Social Activity

A. Objective

1. Perceptions)
2. Uses)of communication technology
3. Effects)

B. Scope and Types of Technology

1. Study locale

   a. home
   b. non-formal educational setting
   c. church and community organizations

2. Technology

   a. broadcast (radio and tv)
   b. cable tv
   c. video cassettes and recorders
   d. audio cassettes
   e. telephone
   f. satellite communication

C. Research Methodology

1. Units of Analysis/Respondents :

   a. Producers/Distributors of Communication Technology

2. Research Methods

   The Case Study Using :

   a. survey/questionaires
   b. Delphi Method
   c. Unobstrusive and participant observation measures

JAPANESE EMPLOYMENT PATTERNS IN THE INFORMATION ECONOMY: POINT OF DEPARTURE FOR THE PACIFIC BASIN?[1]

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1. Abstract

This paper briefly discusses aspects of Japanese employment practices which are judged to contribute to successful industrial development. The case is made that the Japanese have consciously evolved a "socio-technical system" which matches human needs and technological demands. Several ways in which other nations might benefit from Japanese experience are suggested.

In less than a decade, Western observers have swung from the view that the Japanese economy is "Underdeveloped" to the view that it is a model of efficiency. The change is largely the result of Japanese dominance of world markets for automobiles and electronics. While this success might be attributed to a number of factors, Western analysis have recently focussed on the role of management and manpower policy.[3]

In this paper, I will attempt to briefly review a few aspects of manpower policy which I believe have given Japan "comparative advantage" in applying human resources to the problem of industrail development. I will try to make the case that manpower planners can draw insights from Japanese experience, as long as they remain sensitive to the historical and functional aspects of both the system from which they wish to borrow, and the system to which they wish to transfer past experience.

A Socio-Technical System

Japanese employment practices have been successful because they are generally consistent with one another; in other words, they form a coherent system. For example, the widespread use of the "working group" (rather than the individual) as the basic unit of production is consistent with the high value placed on group participation, a value rooted in the agricultural village of the past. Similarly, Japanese egalitarianism is expressed not in the Western concept of "equal pay for equal work" but in the concept of "equal pay for equal need".

Furthermore, industrial tasks have been successfully modified to fit these deeply rooted values. Japanese employment practices therefore form what may be called a "socio-technical system", that is, a system which effectively integrated technological and social demands.[4] This contrasts with what has been called the "technological imperative", whereby social values are dictated by the nature of the job.

Japanese industry did not achieve this integration at a single stroke nor by accident. In fact, the experiments with industrial development before 1945 were marked by a strong tendency to subjugate human needs to technological imperative, for labour was seen as a cost to be minimized to allow the importation of foreign materials and machines. These experiments were essentially unsuccessful; the Second World War destroyed Japanese industries that were decidedly inferior to their Western counterparts.[5] In the postwar reconstruction, Japanese industry was driven in a new direction, partly by new leadership, and partly by legalized labour unions and other reforms instituted under American tutelage.

A key factor in subsequent changes in the relationship between technology and labour was the "Densangata agreements" of 1947. These were a series of initial contracts between the new unions and management. Their outstanding features were the concept of "lifetime commitment" between employer and employee, and the seniority-merit system wage system. Lifetime commitment on one hand helped the firm to retain the skilled workers necessary for its operation, but on the other hand compelled it ot treat labour as a more or less fixed input which would have to be trained to deal with changing products and processes. Since American tutelage offered access to markets and technology, Japanese firms were able to start thinking of their workforces as fixed assets rather than costs. As we shall see, the seniority-merit wage system became the mechanism for developing and deploying this asset.

The Seniority-Merit System

As its name suggests, the seniority-merit system has two basic parts, each contributing to the determination of a worker's wage. The seniority part gears the wage to the worker's needs over his lifecycle. The merit part adjusts this wage to the worker's performance in the context of his working group. In firms where some variant of the seniority-merit system is used, new workers are typically recruited directly from high-school or university an they graduate in the spring. The recruits thus form an age cohort, which will generally advance through the ranks in lockstep. If they survive the first few probationary years, the recruits can look forward to a steadily increasing income over their careers as "standard employees" of the firm. Such a wage-profile is shown in Figure 1. As the figure shown, the prospects for a "non-standard" employee who moves about the job market are not so bright.

From a planning perspective, the seniority-merit wage system serves several useful functions. First, workers are readily persuaded by their long-term prospects to remain with the firm. The firm thus retains a stable workforce that can be developed to meet future needs. Furthermore, the firm can provide training in general skills, which have greater long-term utility than firm-specific skills, with the assurance that trained workers will not move to a rival company. Secondly, the costs of selecting and training long-term employees is shared by the firm and the employee, for in his probationary period the employee is paid less than his theoretical value (see the left-ward extension of the upper curve in Figure 1.) Thirdly, the firm can plot its long-term manpower costs, and plan its investments in human capital and other assets with some degree of accuracy. Similarly, the other investors in human capital- students and their parents - can weigh the costs of additional years of schooling with reliable estimates of the returns. As a manpower planning tool, the seniority-merit wage system has been an important factor in minimizing wage inflation in the Japanese economy. It has also facilitated increases in productivity and assured that they are shared with the workforce.

The Working Group

As suggested earlier, the concept of hiring for life and paying a steadily increasing wage would seem to create a massive problem in matching human skills to the changing demands of production.

North Americans generally try to solve this problem by perfecting the match of skills and jobs, refining their definitions of occupations and their methods of predicting future needs. This approach is clearly based on the assumption that there should be a unique match between a given production task and an individual's set of skills.

The Japanese approach is quite different. Because of the difficulties in predicting future supply and demand for skills, because the core of the workforce is premanently attached, the goal is flexibility: work-related skills are seen to be the attributes not of an individual but of a group assigned to a task. School graduates are hired on the basis of general ability and potential, and they soon identify with their working group, rather than an occupational class. Flexibility is developed by rotating employees through different jobs and by providing a mix of on-the-job and formal training.

The Role of Organized Labour

Unlike their North American counterparts, Japanese unions are generally organized at the enterprise level. That is to say, a single union encompasses all the workers at a single plant or firm, cutting across what Westerners would see as occupational or class distinctions. The fates of the firm and the union are thus intertwined; the line between managers and the managed is thus blurred.

These structural features have enabled Japanese management and labour to deal through compromise with forces that challenge the enterprise, like technological change, inflation, and market shifts. Partly because the relationship between management and labour is not seen as a zero sum game, both sides have been able to use their respective powers to further their own ends without endangering the enterprise as the means.

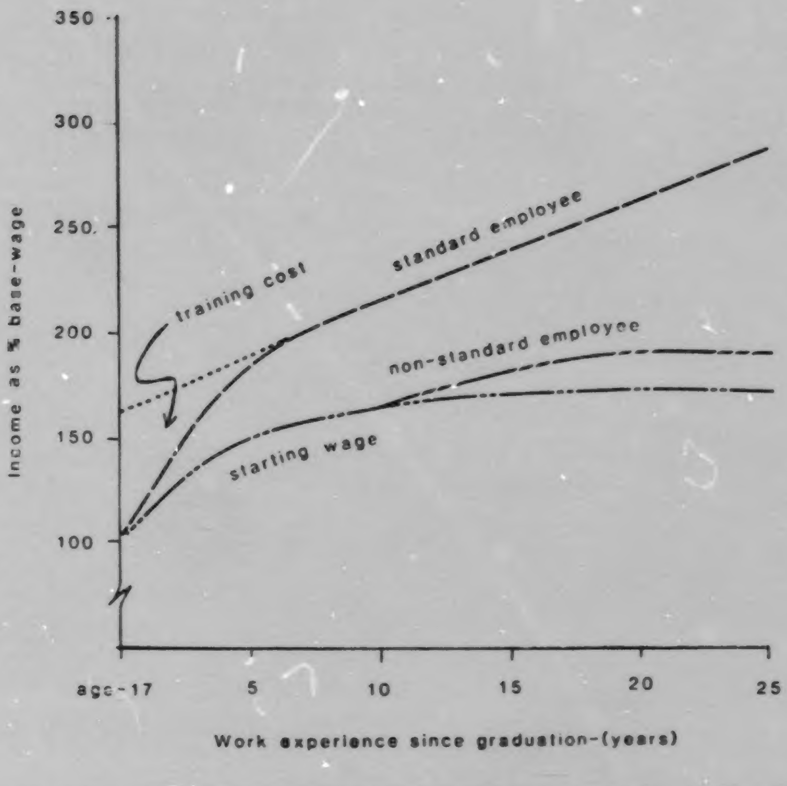
Japan's Comparative Advantage in Manpower

This brief discussion of a few salient employment practices gives some indication of Japan's comparative advantage in international markets. As a socio-technical system, these practices embody principles of human capital theory, encouraging the investment in education and training and ensuring that the returns are distributed among all investors. Japan's workforce therefore attains a high level of formal education before entering the job market. The practices of hiring from school, deploying skills in working groups and training on-the-job ensure that this potential is realized, rather than lost in a debate over the underemployment or overemployment of graduates. The transition from school to work is relatively smooth; new constellations of skills can be arrayed against changes in products or processes.

As a system, these employment practices generate what has been called "organizational capital", that is, an accumulation of characteristics embedded in organizational form that raise labour productivity.[6] A firm may generate organizational capital in the following ways: (1) by organizing itself in such a way that it optimizes the match between each worker and his associates; (2) by the skills of each worker and the demands of production; (3) by organizing itself so that the workforce becomes increasingly efficient (that is, the firm takes advantage of the "learning" or "experience" curves [7]). In addition, when organizational forms meet the above criteria they become the norm for firms competing for manpower, organizational capital is generated in the society as a whole (that is, economies of scale are achieved in labour human resource development).

It is to be expected that these practices will offer even further advantage in the "information economy", for an educated workforce not only accelerates the development of new products and pro-

Figure 1.



Profile of annual income as a function of experience inside (standard employee entering from lower secondary school) and outside (non-standard employee entering 10 years after graduation) a given manufacturing firm. 100%=528.000 yen, starting wage for an inexperienced 17-year old male. Data for Japan,1973, and method of graphing from Table 1, Nakamura,1975.

cesses, but speeds their diffusion, application and consumption as well.[8] In the case of electronic goods and services, flexibility is increasingly important as it becomes possible to respond to changing technology and fragmenting markets by means of ever shortened production runs. This flexibility can be cultivated by grouping workers with overlapping skills. Sharing duties and responsibilities also spreads foreknowledge of work goals and feedback on results over a broader base of intelligence, thus accelerating the pace of innovation: the working group itself becomes an adaptive system.

Japanese Experience as a Model

On most measures, the Japanese have achieved remarkable success since 1945 in re-industrializing their country. Can their experience be used as a model of industrial development in other countries? This question must be broken down into a series of sub-questions.

The first is, Do practices like "lifetime commitment", the seniority-merit wage system, and working groups adequately characterize Japanese experience? It is difficult to determine the precise percentage of the work force covered by "lifetime commitment", for Japanese labour contracts do not record agreements of this kind. A reasonable estimate is that 30% of the workforce is covered, and are accordingly governed by some form of the seniority-merit system and its adjuncts[9]. While this may not seem to be a large proportion, there can be little doubt that the ideals embodied in these practices influence a far larger part of the workforce. It is safe to say that the "salary-man" model, which derives from "lifetime commitment" in both white collar and blue collar jobs, dominates decisions on career paths in Japan. As a goal to which upward bound youths and their families aspire, the "salary-man" model has a much broader impact on work organization than its statistical incidence would imply.

The second sub-question is, Are Japanese practices culturally determined? Group orientation, to take one as a example, does have parallels in pre-industrial village. However, it is not hard to demonstrate that this practice and others are modern inventions, applied rationally to modern problems.[10] The fact that these inventions echo deeply rooted traditions illustrates the thoroughness of Japanese industrial planning.

A third sub-question is, What sorts of lessons can be drawn from Japanese experience? At the most general level, this experience demonstrates that a productive and innovative workforce can be consciously and rationally developed from an indigenous economy with what appears to have been an extreme degree of labour surplus. In fact, until recently, Japan had a very large population but a shortage of labour suitable,skilled and movitated to meet the technological demands of industrialization.[11] The fact that the task of developing suitable human resources has been successful should encourage nations facing similar problems in the Pacific Rim.

More specifically, Japanese success can be largely attributed to the development of an effective educational system for developing general skills (literacy, numeracy) and an effective means of deploying and further developing these skills on-the-job. The case is made here that the seniority-merit system plays an important role in both these aspects of effective manpower policy. In contrast, in Western nations, especially the english-speaking ones, the educational system is highly refined, but its relationship to the demands of working life is poorly defined. In this respect, Japanese experience forms a better model of human resource development than North American counterparts.

Most specifically, Japanese success may be attributed to individual techniques for organizing industrial production. Borrowing Japanese practices has reached the intensity of a fad, particularly, in the case of Quality Circles. There is a danger here that planners will ignore the context from which Japanese practice is lifted, and the context into which it is inserted. Another factor in Japanese success is that planners tried to borrow from "best available practice" only those elements that they judged useful or adaptable to their own situation (for example, Statistical Production Control, an American idea applied in Japan). There is some evidence that this sort of careful adaptation of Japanese experience to local needs is happening in the North American auto industry.[12]

Japan's industrial development does present a stimulating case study, from which useful models may be drawn. The task of discerning and applying these models is a difficult one, for the manpower planner must be attuned both to the functions and origins of Japanese practice, and those to be modified. Fortunately, knowledge is accumulating about human resource development in Japan and in other nationa in the Pacific Rim. The greater challenge lies in trying to apply this knowledge.

FOOTNOTES

1) This paper reports on work conducted in conjunction with Dr. Nozomu Takasaki and Professor Tadao Yamagishi, at R.I.T.E., Tokyo. I would like to thank them, and Dr. Toshiaki Izeki, Keio University, for their advice and assistance.

2) Concordia University, 1455 de Maisonneuve, Montreal H3G 1M8, Quebec, (514) 879-4210.

3) See for example, Ouchi , or Pascale and Athos.

4) See Trist on socio-technical systems.

5) For example, Blumenthal's work on shipbuilding.

6) Prescott and Virscher.

7) See Abernathy and Wayne.

8) See Dicks, Appendix 1.

9) Dicks, Chapter 4, Note 8.

10) Dicks, Chapter 2.

11) Taira, Chapter 2, and Dicks, Chapter 3.

12) Financial Times.

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Progress in Information Systems and Use

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Abstract

Progress in technology available to the Pacific Basin has been substantial in the past year. These changes involve new telecommunications facilities, and information processing tools used in conjunction with the telecommunications facilities. While others will be describing ISDN and 5th generation computational capabilities, this paper shows how LAN's serve many applications of interest to the Pacific, how Standards are being established so that products can cooperate, and interact with the ISDN and open system interconnection.

1. INTRODUCTION

It's a pleasure to be here again in front of the PTC '84 and to be able to provide an update to you for the Information Industry's progress and products and for the status of the standardization of these products that are of great interest to the various entities in the Pacific Basin. I will focus upon the features of these products that are especially useful in the Pacific Basin's topology and economy, present and future. In my past presentations, I have attempted to acquaint you with some of the telematic services, with the organizations who can provide standards for use to the Pacific Basin entities on an International basis and to the activity in that standardization area, particularly as it affects Local Area Networks and the interconnection of these services. I do not have new buzz words or a new territory to explore with you today; but, rather, I wish to report the progress in greater depth and the degree of worldwide interest the subjects previously introduced to you, and how close their results are to implementation for your benefit.

1.1 Information Industry Trends

A question that many industries have been asking themselves lately is "What is the Information Industry?" And the second question follows very closely, "Is it me, am I part of this Information Industry"? Or perhaps, in a more selfish way, I would ask "How can I get into this act"? Regardless of their motives, and regardless of their capabilities and the practicality of their belonging and performing in the Information Industry, the fact is that the blur is continuing to grow between the heart of the Information business and the rest of the area. A major example of this is an effort called Home Electronic Bus, more of which will be said in a substantive way later in the Paper. It does not require a great background in philosophy to make the cogent observation that almost every device around the house has some kind of a microprocessor in it. While its processor may not be used for classical mathematical studies, it does serve a useful purpose inside the device in which it is located, and to create a more automatic function for that device. There are many devices performing many kinds of functions. If you were to ask yourself, "What does a microwave oven, a burglar alarm and a TV recording system have in common?", the answer comes out, "other than the electrical power driving them, they all contain a micro-processor. Looking a little more deeply, you find that you'd like to use the TV recorder, at a time when you are not at home, to capture your favorite soap opera or sports event for reviewing at a time when you are at home. You'd like the burglar alarm to let you in when you are ready to come in, but to catch the unscheduled visitors. You'd like the microwave oven to come on and produce the dinner in a short time -- when you are ready to eat it, not at any time when the oven is ready, or when the power company has watts to spare. And so the reasoning continues -- why can't we interconnect these many devices? And the answer, of course, is that we can; that is, we could if certain parameters were common, were the same kind, were interconnectable, but they probably are not. It has been sadly observed by one manufacturer of many of these products -- a multiproduct, a multinational corporation whose several divisions producing these products are quite autonomous (certainly they are in technical matters) -- that the remote control for the TV set, for the audio system, for the electronic blanket have nothing in common. To make matters worse, they may indeed have radio interference between them, and are unable to produce a desired results amongst the many factors that are subject to control in each product area. I am sure that we all realize that not every part of the Pacific Basin is a market for electronic blankets. I think that the principle that is being applied here is clearly of interest, not only to the Pacific Basin, but worldwide: that we are at a stage where the thinking about this kind of integration will allow us to find a common denominator for this interconnection. Over the next 5 years, we will start to make sense out of the total gamut of electronic products that might be utilized in a home, a small business, even a medium sized office or a large factory. But you see that the makers of electronic blankets and microwave ovens and many other devices now find themselves a potential part of the Information Industry. We must now find a way to talk to them in a language that has grown in their respective industries as well as to the Information Industry people.

1.2 Telecommunication Trends: Interconnection

So while we are getting started in this new area, we should also note an area that another speaker on this Panel will be covering in much more detail -- the Integrated Services Digital Network. On one hand, ISDN is the major interconnection of a wide variety of analog and digital types of communication links that have grown up over the years to service voice, data and video needs, and to interconnect them internationally. Knowing these varieties of products and their different bandwidths, the CCITT had started a study in the previous study period, and formalized it under Study Group XVIII for the '80-'84 period. Much progress has been made, but there still are many tough technical problems to be solved. There are interconnections of networks, some private, some public, but mostly networks that have been in service some time, but yet have much economic life left to them. The interconnection problem with conversions at gateways, etc. remains a strong problem economically. So the interconnection of the terminal or processing system to the ISDN has many functional aspects, many logical interface parameters, much protocol to pass across this interface. And at the bottom of the heap, the bottom, logically anyway, is the simple connector, the 8 pin modular connector, a type of design which has seen an introduction as the 4 pin connector for voice in much of the territory as served by telephone companies in the U.S. and Canada, at least. It is one of the candidates for this kind of interconnection. It is also one of the candidates that the Information Industry is espousing for connection of their Work Stations, to private, local and public telephone networks. But to those not used to using this particular connector, when attempts are being made to standardize it internationally, words of caution come up: "Why another connector?; lets stop this proliferation, lets really standardize."

While I admit that there are a large number of 8 pin connectors around, that is not the biggest problem in connectors! It is the 3 pin connector! This 3 pin connector that we are trying to introduce at this stage is one that will connect the three guns, one of each color, of a commercial TV set to the outside of the cabinet in such a way that video games (perhaps) and certainly the decoder that is part of Teletext, and other telematic services can use a common television set for the screen of these Work Stations. This benefit to those people who have low levels of traffic in any particular service, can utilize that set for home entertainment, for business, for personal computing and a variety of other broadcast type of services; Services that I think has a home in the Pacific Basin. Of course, this three pin connector has some unique requirements: the RF characteracteristics of the signal variations, the high voltage that may be associated with the particular leads relative to other parts of the TV set, and the compactness of the connector, and of course you want it to be different from other 3 pin connectors so that you will not plug the wrong 3-wire device into your TV set. So, when I hear a request for another 3 pin connector, I have to say, "How many 3 pin connectors are there for extracting energy from the mains, be it 120 or 240 volts?". Compare the practice in Japan, in Hong Kong, in the UK, in Australia, Canada, U. S., both for the mechanical and electrical varieties of earthing, power and physical connections. Then ask how many years has it taken to get to this situation. Well, this is not the place to go through all of the IEC troubles on how to standardize a connector. But I cite them because we are joining up the Information Industry with many areas of electrical manufacturing, and electrical products that have been around for some time, which now must be considered as information products, and we must face the interaction from this point of view.

1.2 Telecommunication Trends: Deregulation & Standardization

There continues to be some degree of deregulation being achievable or made available in a number of different countries. The rate of progress is slower than it was last year, perhaps because several major decisions have been taken and are now being implemented, the meanings of the decisions clarified. More countries are joining, but not all in the same way, nor are proceeding at the same rate. The telematic services have been trying to reconcile video presentations as initially conceived and progressed by joint efforts of U. S. and Canada in North America and various administrations belonging to CEPT in Europe. It is my expectation that the VIIIth Plenary of the CCITT scheduled for October of this year will find a common standard for this area.

2. GROWTH OF LAN's

Local Area Networks, in the most general sense -- that is anything that fits the English words definition thereof - have been around for many years. Regardless of what they may have been

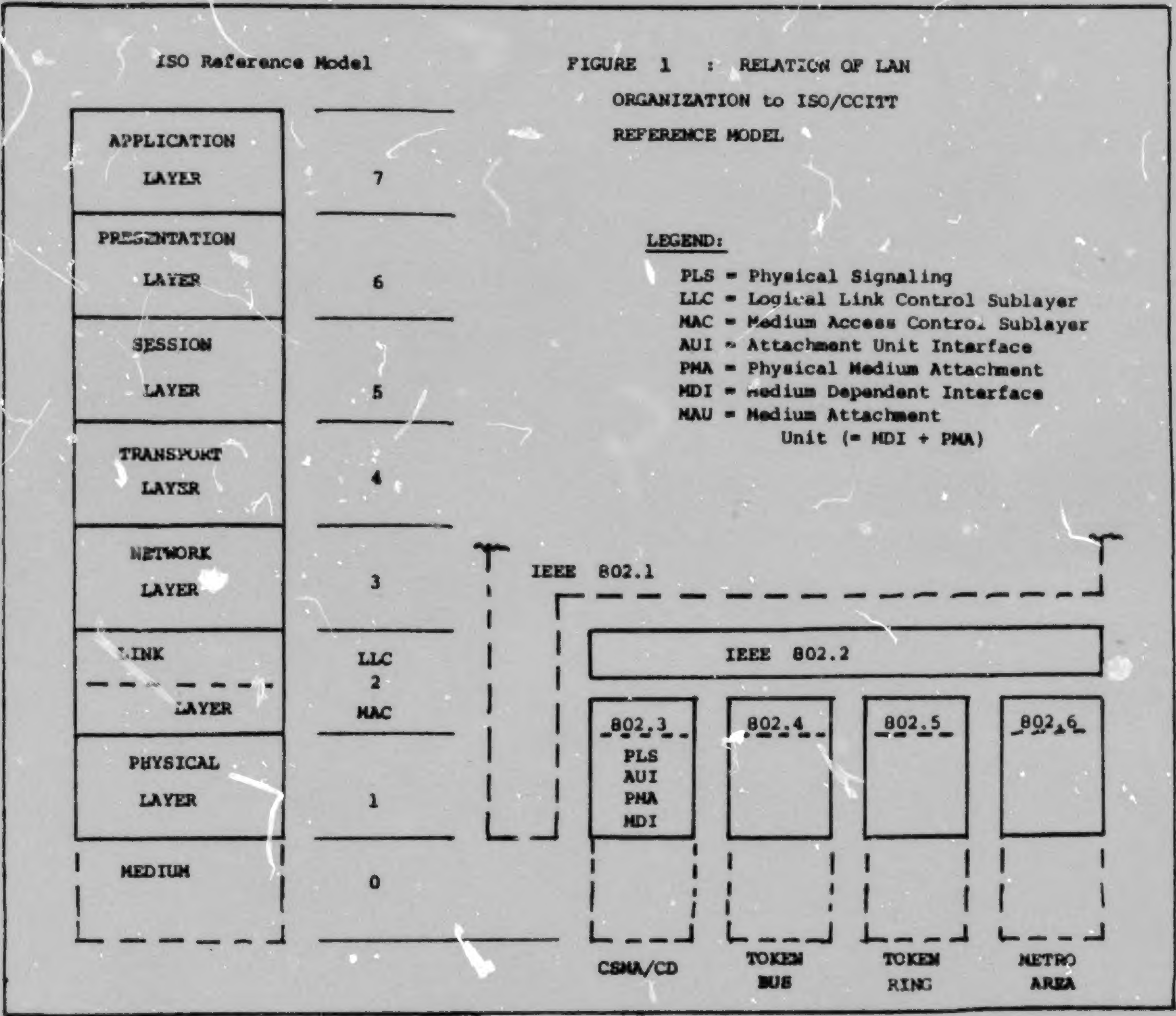
ISO Reference Model
APPLICATION LAYER
7
PRESENTATION LAYER
6
SESSION LAYER
5
TRANSPORT LAYER
4
NETWORK LAYER
3
LINK LAYER
LLC
2
MAC
PHYSICAL LAYER
1
MEDIUM
0
LEGEND:
PLS = Physical Signaling
LLC = Logical Link Control Sublayer
MAC = Medium Access Control Sublayer
AUI = Attachment Unit Interface
PMA = Physical Medium Attachment
MDI = Medium Dependent Interface
MAU = Medium Attachment Unit (= MDI + PMA)
IEEE 802.1
IEEE 802.2
802.3
PLS
AUI
PMA
MDI
802.4
802.5
802.6
CSMA/CD
TOKEN BUS
TOKEN RING
METRO AREA

FIGURE 1 : RELATION OF LAN ORGANIZATION to ISO/CCITT REFERENCE MODEL

called, our Company has utilized a device called Direct Connect. Other companies have used devices called Short Haul Modems. All these provide some kind of an interconnection, if not a network, of privately supplied devices for interconnecting to some communication systems, either private or public. Such technology has been in service between five to ten years. Generally, it is not what is considered today to be Local Area Network, only because other types of Local Area Networks have become more popular. It is amongst the latter area that current efforts in standardization and most of the application of the buzz words LAN are being applied. The definition that people would like to give to LAN then went into a sort of a backfill: take what somebody calls an example of a LAN, describe it and call that the definition. That tends to seperate on the basis of baseband versus broadband, on the basis of station differences, on the basis of bit rates to be transferred, etc. None of these separations is exclusively correct, but they do serve to help, to distinguish between places where LAN type architecture can fulfill a need for interconnecting various information stations. Industrial work has been done by Xerox, (ethernet), by Ungermann-Bass, by Wang and many others. -- (Sorry if I failed to name your company, but I don't have time to be thorough).

2.1 LAN Standardization Activity

In attempts to standardize, we should turn our attention to the work of the IEEE Computer Society, Committee 802. The work started many years ago (my first recollection was at least five years ago) and their goal was to arrive at one single standard for LAN's. For many years, several divergent technologies competed, until it was recognized that at least three technologies covered a wide range of applications and that not one of those three could be eliminated with any great efficiency in favor of either of the other two. Several Access methods are popular, as shown on Figure 1 above. As a result, IEEE had been moving with the greatest degree of progress toward the CSMA/CD, that is the Carrier Sensing Multiple Access/ with Collision Detection, and that this standard come forward in two parts - one for Medium Access Control and the other for Logical Link Control and has been submitted to the IEEE Standards Board in mid summer '83. Token Bus and Token Ring standards, as well as the Metropolitan area standard are also in their program of work and are scheduled for completion and balloting at the Committee level a bit later. Approval would follow at a later date, generally in the next year, at the Standards Board.

Earlier versions of the Carrier Sensing Standards were submitted to ISO/TC97/SC6 as Working Papers for their consideration and study, in fact as early as June, 1981. They have indeed been studied in ISO and elsewhere. ECMA, in their TC24, have carried on the tradition of ECMA, (the European Computer Manufacturers Association) in rapidly bringing to a viable form, at least for the users, a series of standards which have been approved in 1982 by their General Assembly, carrying the notations of ECMA 80, 81 and 82. It is expected that the December '83 General Assembly will have approved upgraded versions correcting the earlier limitations, and bringing them more in line with the technical subject of the IEEE papers. ECMA is also continuing to work and should in '83 have some degree of approval on Token Ring and Token Bus formats. See Figure 2.

Various industries are applying these standards, particularly Process Control and Instrumentation and while they have additional requirements in multiplexing, they earnestly wish to have the basic configurations for distributed systems to be available quickly. In order to have widest acceptance as an International standard, the Carrier Sensing Devices first, and the Tokens later, will be processed through ISO/TC97/SC6. A DP has been registered following their meeting at Tianjin in September of 1983 and should the balloting

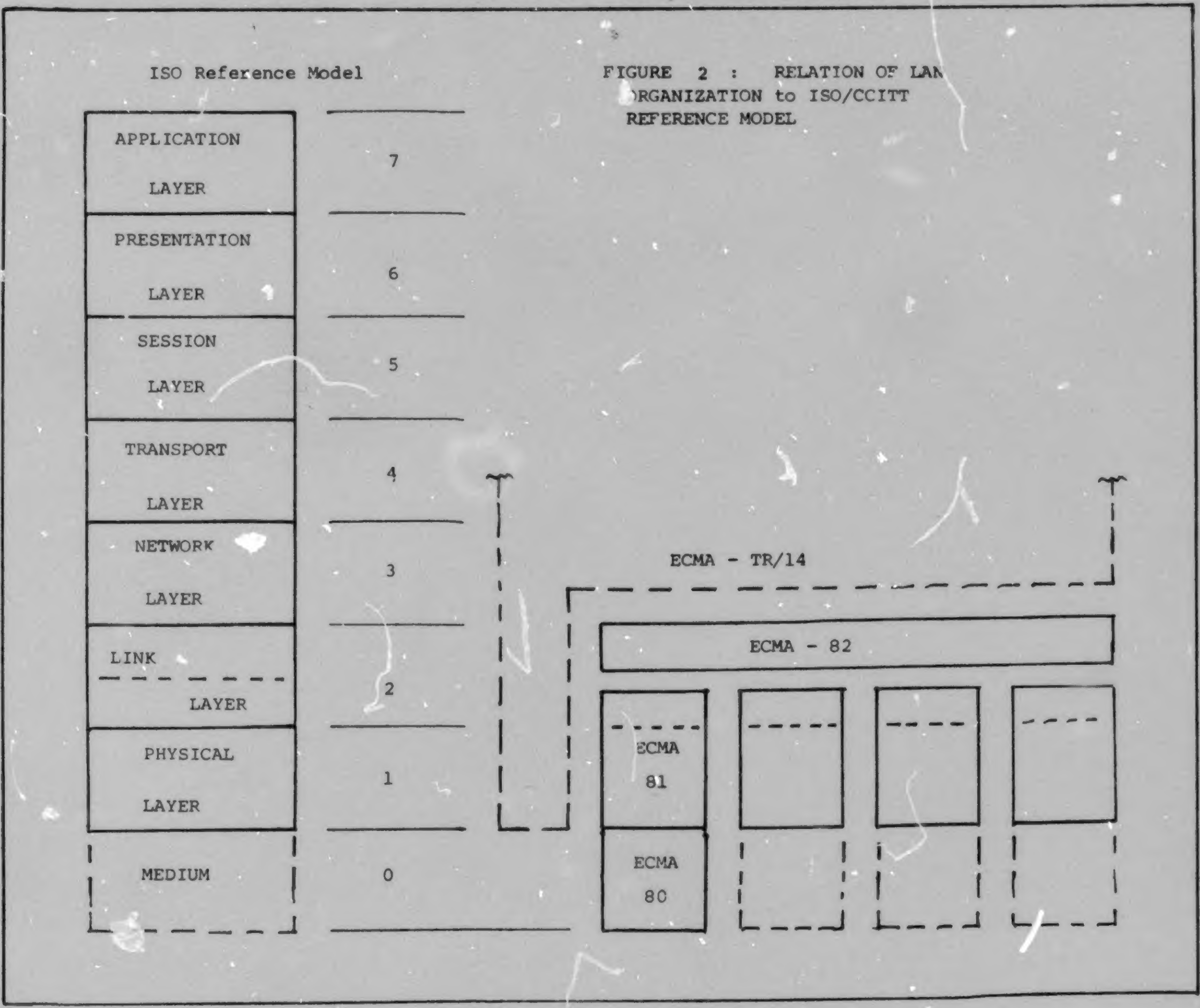
FIGURE 2 : RELATION OF LAN ORGANIZATION to ISO/CCITT REFERENCE MODEL

be favorable, a DIS could be approved in 1984.

Due to user demands, and also to stabilize manufacturing criteria for tooling investments, etc., there is great interest in IEC and their newly formed Committee, TC83, with the title "Information Technology Equipemnt". Procedures have been established between ISO and IEC managements to insure that this high interest does not lead to duplication of effort; with this consideration as an initial study facet, IEC will be looking to ISO to do the basic CSMA/CD standard, and will be looking to formally apply such Delta parameters and application adaptations as are needed in Process Control, such as Proway, and the Home Electronic Bus. I might say, therefore, that there are ample activities now available to produce International Standards for Local Area Networks. Professionals in the field of standardization exist in at least one major and recognized professional society, namely the IEEE, and one major regional manufacturing standardization body, ECMA, and in the combined voluntary international standards writing bodies, ISO and IEC, and that the mechanism exists for the coordination of work between all these bodies. At the same time, this work is now recognized as inescapable activity different from the public telephone network and its services. Gateways can be established to implement the interconnection of the two kinds of networks.

2.2 LAN Interconnection

The second major recognition is the fact that in Local Area Networks many kinds of technologies have been applied to perform this interconnectivity. Most of these started as a means of reducing costs in localized communication systems. Such things as twisted pairs, simple plugs that can be wired by the occupant, station addressing independent of the physical connection, are some of the parameters driving people to get into Local Area Networking. Another driving force is the popularity of the screen based Work Station, which need for wider bandwidth; one sees the cable television technologies as being adaptable to multi work stations on a given ring, loop or bus as a means to satisfy these bandwidth demands. Another user service, which is a driving force, is digitized voice, for the security that goes with it and for the store and forward voice capabilities and data basing. Teleconferencing is still another attractive application, but may not be economically justifyable for a decade or more. There is also much concern for safety of these private installations as well as quality of performance. This has caused consideration of fibre optic interconnections for high bandwidth, isolation, and minimization of crosstalk and interception. While all of these particular features may not be immediately interesting or economically useful to the Pacific Basin, I cite them as a means of identifying the driving forces which LANS are subject to today. Digital PABX's are moving forward as well, and these may influence how fast some of the LAN's will come into service. With microwave and satellite connections leapfrogging many of the wire connections between the cities, there is now competition in a number of countries for basic long haul inter-city communications. These circuits esentially compete on a voice or a voice multiplexed basis; data can be carried, of course, on these circuits. The competition in a more localized, that is metropolitan type of situation, is not commercially viable yet, although there are some services tariffed. The competition is not head for head. For instance, cellular radio and other forms of mobile radio provide a means of getting between several points inside a city in lieu of the commercial telephone system; they also can be used in rural, semi rural or island communities where stringing wires between the points is either too expensive or impossible. Standardization in these areas so as to provide transparent service to users is not underway to any practical extent at this time, but it undoubtedly will come as new territories are licensed and new technologies are found to be effective for that kind of service.

2.3 Description of popular types of LAN's: Impact of the OSI Reference Model

At PTC '83 we had spoken a little bit about LAN's and we addressed the subject from the standpoint of the devices to be interconnected and how they were distinguished from other forms of distributed processing and communications systems. I will attempt today to identify forms of LAN's with respect to their conformance to the ISO Reference Model (which has been provisionally accepted by the CCITT, as Recommendation X200). The several media and several access methods to those media that are to be used to relate the Local Area Network approaches to other approaches already in service on public and private networks, but utilizing the technology of public communications systems. To focus properly, I will refresh your memory with the Open Systems Interconnection concept and the Reference Model for Open System Interconnection. The work that I have previously described in ISO Standardization dealt with a number of subjects being covered but one was the ability tointerconnect to a data processing system, made by one vendor and used in some particular country with terminals that might have been made by other vendors, perhaps of different countries of origin. These interconnections would be compatible in all essential respects because the system concept from the user to the physical medium that would interconnect them would be related by a series of interfaces and a series of protocols that permitted communications from peer levels at the terminal and at the computers, and also communications through the several layers of the model from the user to the physical medium, or back up again in the reverse direction. Seven layers have been agreed upon over a number of years of work on the Reference Model, which bears the identification of IS7498. This Model deals with what we call "connection-oriented" communications, namely, that the messages sent from one place to the other are done in an accountable fashion; receipt is acknowledged by the receiver with a transmission back to the sender and future messages are identified message by message and block by block so that errors in transmission can be corrected in the smallest element of the traffic, as opposed to a total retransmission. Not all systems need such careful accountability, and so a "connectionless" form is being added to the Model. The connectionless transmission allows a sender to presume that the receiver is ready to receive, sends him the stuff, hopes that he gets it, (presumes that he gets it, in fact), and proceeds on with the rest of his senders duties whether they involve that receiver or some other. After a reasonable time, if nothing has happened to indicate whether or not the receiver got his message, and it is of some importance, the sender may try again, but it is his responsibility to determine whether or not he should try again. The sender can accept the traffic, ignore it, use it or whatever, such is the nature of that traffic. Both of these forms are of interest to LAN applications (which is why I mentioned them here).

2.4 Logical Link Control

The Local Area Network developments center about systems that make use of the Reference Model and affect only layers 1 and 2. Anything occuring in the network layer or higher would be done in exactly the same transparent manner as if they were connected to a packet service using an X25 Lap B and Physical media attachments or an X21 physical medium in layer 1. The LAN's therefore, are transparent insofar as the user is concerned, provided he exercises the correct high-level selections of his medium to the extent that he has such options available to him. Now, directing our view toward the LAN features per se, we see that the most popular development work in Standardization of Local Area Networks in Layer 2 deals with a Logical Link Control which provides the means of forming the frames that appear on the physical media and provide the basic error control or recovery operations. That represents a part of the basic level 2 features. The interface between level 1 and 2 would be achieved only by utilizing a Medium Access control that is compatible with the logical link level control and uniquely compatible to a particular medium. There are three media that are being considered in the standardization work today. One is called Carrier Sensing Multiple Access with Collision Detection, or CSMA/CD. This allows the sender to attempt to call by his proper address any potential receiver in the community that he wishes. He may be able to get access to the medium to do this at the instant he so desires, or there may be a conflict in that somebody else is already using the medium in which a mechanism is provided for the sender to wait and try again at a more appropriate time, and of course that brings the interesting comment to the foreground of "What happens if two people try to get control of the medium at the same instant?" Well, their attempts will identify to each other that the carrier has been turned on by each of them, the carrier being sensed at that time and as they back off the first time, one has a timer of a different duration than the other. The one with the shortest timer would make the next try sooner than the one with whom he had a collision. Perhaps he would now be colliding with someone else; but, if he didn't then he would gain control and get his message and the other fellow would wait his next turn, and probably would have access at that time. If again there was a collision the same process would reiterate and if all the timers are spaced out correctly, and if the traffic is not overloading the system, everybody should get access in a reasonable time. The technique could utilize a number of different media, depending on the data rates concerned. We will speak more about the optima and the range of medium opportunities later. For the moment, let us say that the most popular approach is to utilize 75 ohm coaxial cable such as the CATV industry has popularized and has made many components economically available in mass production. Individual subscribers tap the 75 ohm line with a 50 ohm short stub.

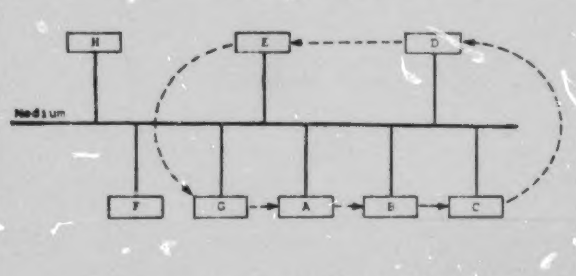

Figure 3 Logical Ring on Physical Bus

2.5 Token Access Method

As shown on Figure 3 the second very popular method utilizes token passing: in this case, control of a network and ability to access it relates to the person who owns the token. When he wishes to speak, he passes it to someone else or he is obliged to relinquish it to the next, predesignated person on the ring or bus if he has no traffic to send. The token is passed to the person he wishes to talk to and is held by him until he has received his message and perhaps put out his answer.

The essence of the token access method follows:

- A "token" controls the right of access to the physical medium; the station which holds (possesses) the token has momentary control over the medium.
- The token is passed by stations residing on the medium. As the token is passed from station to station a logical ring is formed.
- Steady state operation consists of a data transfer phase and a token transfer phase.
- Ring maintenance functions within the stations provide for ring initialization, lost token recovery, new station addition to logical ring, and general housekeeping of the logical ring. The ring maintenance functions are replicated among all the token using stations on the network.
- Node address recognition.
- Frame encapsulation (including token preparation).
- FCS generation and checking
- Valid token recognition.
- New ring member addition.
- Node failure error recovery

At any rate, the protocol for token passing occurs in the medium access level and is unique to the token passing scheme.

2.6 Medium Access Control

The Medium Access Control (MAC) sublayer provides sequential access to the shared bus medium by passing control of the medium from station to station in a logically circular fashion. The MAC sublayer determines when the station has the right to access the shared medium by recognizing and accepting the token from the predecessor station, and it determines when the token must be passed to the successor station. General sublayer functions:

- Lost Token timer
- Distributed initialization
- Token holding timer (for multiple classes of service)
- Limited data buffering
- Node address recognition
- Frame encapsulation (w/token preparation)
- FCS generation and checking
- Valid token recognition
- New ring member recognition
- Node failure error recovery

There are two token passing schemes that are quite popular. One is called The Token Ring, the other The Token Bus. The Ring and the Bus are related to the physical layer, the actual physical configuration; that is, in the Token Ring the cable returns to itself, be it single or bi-directional, or in the case of high reliability it is possible that there is twin single-direction cables utilized for opposite directions of traffic. These cables again are the 75 ohm variety. More is to be said later with regard to the need for restoration or amplification of the signal to insure reliable communication over reasonable distances: that is, regenerative or repeater amplifiers. In the token ring, the token finally returns by travelling around the ring from station to station, being handled or not being handled until it is back to the initial sender. The fact that some station is the initial sender has no logical significance to the system; it could be anybody. There is a feature of the procedure usually available to deal with lost tokens or tokens to be recovered and reassigned. In the token bus configuration, the cable does not return to itself but actually looks like a linear snake going from one station to the other. There is usually a head-end device which would act as a controller. However, as you see in Figure 4 below, the frame always contains both a

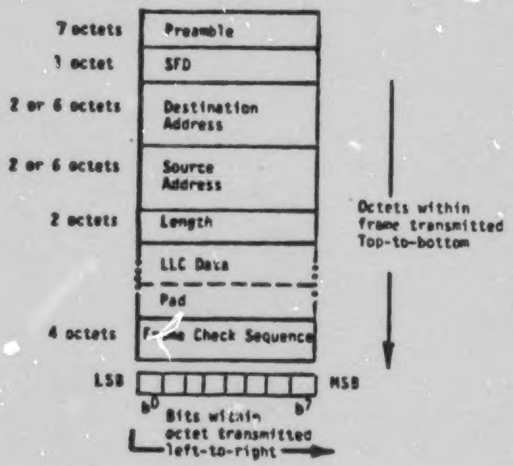

FIGURE 4 : MAC Frame Format.

destination address and a sender address. The logic of the access control device is such that a token that is addressed to somebody other than himself is logically sent on to another station, a particular other station whether or not it is the destination station. Eventually, therefore the sequence of stations will have been exercised and logically the token will have returned to the sending station and be forced to go round the ring again and again - with or without traffic following it. And so, logically, the token bus is also a logical ring. We see therefore that there is a distinction in these three access schemes that relate to the medium itself, the topography of station locations, the traffic rates, the uniqueness of traffic from a given station in volume, frequency, length of messages, and in the manner in which the physical medium itself may be selected. For the moment suffice it to say that each of these three popular schemes has merit and some application support, it is expected that all three types will have been standardized fairly shortly. Figure 5 shows the logical structure of the MAC layer functional partitioning for a Token Bus. Concentrating on the medium itself, this normally would be of very low interest to users because the reference model is designed to make user-to-user communications possible in a transparent manner, with the user knowing least about how the message gets to his correspondent and frequently without even caring what medium would be carrying the traffic, as long as it was carrying it efficently for the application involved. However, in the Pacific community the selection of the media is quite important and the traffic level is generally lower than it would be in a highly urban situation. This will be discussed in Section 4 below. These factors per se do not detract from the LAN architecture.

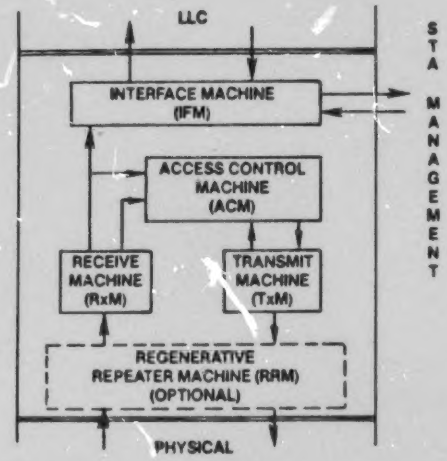

Figure 5 :MAC Layer Functional Partitioning Token Bus

2.7 Salient Feature of LANs.

In a slight aside, our company has utilized a Token Ring in the primitive form in one relatively small sales office involving 20 stations or less, using twisted pairs for interconnection and data rates of approximately megabit per second. All stations were screen-based and the Token passing scheme had thousand bit messages, of course with some control messages shorter, but generally of that size, and a physical ring was utilized. The Medium Access controller was one of our many either large micro or small mini computers and this was entirely workable. Our company has also made specific small Token Passing Networks primarily for the sake of interconnecting networks whose characteristics and protocols were not compatible with each other, directly. It served primarily to prove that disparate networks could be interconnected. As standards develop for a reference level connection through the ISDN work, which is the subject of another paper, the second illustration that I gave you will no longer have any economic neccessity.

For today's presentation, therefore, and particularly this portion of it, I will try to concentrate on the most popular form of the medium, and popularity is measured by the approval that has been received on the standards describing it. Sometimes I wonder whether we aren't getting into implementation specifications insofar as the medium is concerned but nevertheless it is helpful for this audience to describe what they are considering. And while I have indicated my own company's experience, I would be remiss if I did not mention that much of the CSMA/CD work is based upon Xerox activity as they had designed into ethernet, and much of the Token Bus comes from IBM's developments. Many other companies have also been very active as we have indicated elsewhere, and we do not wish to omit nor over emphasize the benefits that these several developments have made available to the standardizers and ultimately to the users of all Local Area Networks. The major effort in the standardization activities is in the IEEE 802 Committee. Four or five years ago there was hope that they would arrive at a single LAN standard; such has proven to be impractical because more varieties are needed. They have benefitted from the debates in that area and they have had a draft which is being polished now consisting of a multi-standard family -- 802.1 is a general system description of how all of these standards relate. The accompanying Figure essentially describes their inter-relationships on a block basis. 802.2 represents the logical link standard and that is common to all of the media access standards and it occupies the upper sub-layer of layer 2 of the Reference Model. 802.3 is the medium access standard for the CSMA/CD mode of access. It includes the full description of the devices in Level 1 as well as in the lower sub-layer of

Level 2 and it also contains great description of the cable itself, the cable stub and the interconnections between the backbone and the stub. In other words, a Level 0, Level 1 interface between the DTE (that is, the Work Station) and the medium, is a 15 pin connector that has been utilized for X21 interfaces in ISO and IEC Data Comm and connector standards. 802.4 is the Token Bus standard, medium access. And the 802.5 will cover a metropolitan area. I have said all that I know and all that we need for this meeting about 802.5, perhaps more will develop later. At any rate, it fits the format that would be one more alternative to the medium and would require unique apparatus and protocol in Level 1 and the lower layer of Level 2 of the Reference Model.

2.8 Comparison: LAN to HDLC

Having pointed out the similiarities and having noted a few of the most major dissimilarities between LAN's and systems involving Work Stations, Computers and Public Telephone Network types of communications systems we should point out some other significant dissimilarities. In the HDLC Logical Link Level, a frame structure is built up utilizing a preamble or flag, containing a destination address, eventually getting into control bits and then the message, and winding up with a frame check sequence of some sort, and ending with another flag identical to the opening flag bit sequence. There is a distinction in the size of the address in normal Level 2 procedures, there is an 8 bit address sometimes expandable to 16 for stations that need more exclusivity or for very high populations. In the LAN area either a 16 bit or a 48 bit address is utilized. A destination address is always followed by the sending station address. This is a neccessity in Token Systems, of course, but it has been considered desirable in HDLC systems as well, although not included in that standard. The address is associated with each station. When the station is sending, it's address appears as a sending address, and when there is a message for it, it is the same station address that appears in the destination address field. Another difference is in the check sequence; a 32 bit polynomial is used in LAN work while a 16 bit CCITT frame check sequence is utilized in HDLC and X25. It is also used in V41. HDLC considers a 32 bit polynomial for applications with noisy transmission systems or satellite hops. The former is probably the reason why LAN's have adopted a polynomial of this size, although the ability to utilize a contention satellite scheme with the CSMA/CD should not be discounted. I will not at this time attempt to describe connectionless differences since these are in a somewhat more fluid state, insofar as standardization is concerned.

2.9 LAN Standardization

We have acknowledged in the above descriptions the work of the IEEE 802 Committee and the the various documents that they are turning out for standards. We should not neglect the work of the ECMA Technical Committee No. 24 who have been apprised of the IEEE work and who have attacked the documentation of these standards in a different manner intending to produce an application-oriented family of standards. In June of 1982 the General Assembly of ECMA, the last approval body, gave their approval to Standards 80, 81 and 82. These three together cover the same territory as IEEE 802.2&.3. 80 and 81 together correspond to the cable and medium access control while 82 corresponds to the 803.2. ECMA have developed a transport layer protocol, but have not yet developed a network layer protocol. Within their documents they refer to those and the transport layer protocol carrying a standard, ECMA 72, and also to a technical report No. 14 which would correspond to 802.1. The ECMA documents have less implementation detail and read more like a conceptual document than a specification. Details on the several documents are available in the bibliography at the end of this paper. We urge that you read them. They are not inconsistent if you pick the versions that occur at the same point in time. The only inconsistency you might find over the last several years work has been the fact that one organization may be slightly out of step with the other with regard to publication and approval. We should also note that there are standards that have been developed in ISO at Level 2, namely IS4335, IS7809 and IS3309. These standards relate to an integrated Level 2 HDLC and are fully compatible with LAP B of the Level 2 portion of X25. As we mentioned before, IS7498 represents the Reference Model and the CCITT equivalent Reference Model is recommendation X200, presently a provisional recommendation but it is expected to be converted to a firm recommendation by the Plenary meeting late this year.

As you read these papers, should you take the trouble to do that, you will see the enormous detail that occurs in the execution of these protocols; however, microprocessor chips are coming on the market in an economic manner to execute this logic quickly and cheaply; and while I have exhibited the rather compact, and I hope clear, overview of what is happening, the chips will do the dogwork to an extent that has not been happening at some of the more classical protocols at this level.

3. TECHNICAL ACTIVITY IN ISO, IEC & ITU

In the previous papers, we have described much of the activity which is going on in ISO and IEC. My paper of last year summarized some of the highlights of Committees 6, 16 and 18 of TC97 in ISO. The principle Information Systems Technical Committee in IEC is TC83, which is just getting off the ground. Also we should consider TC65 where process control is being worked on in IEC, and TC60 where audio visual

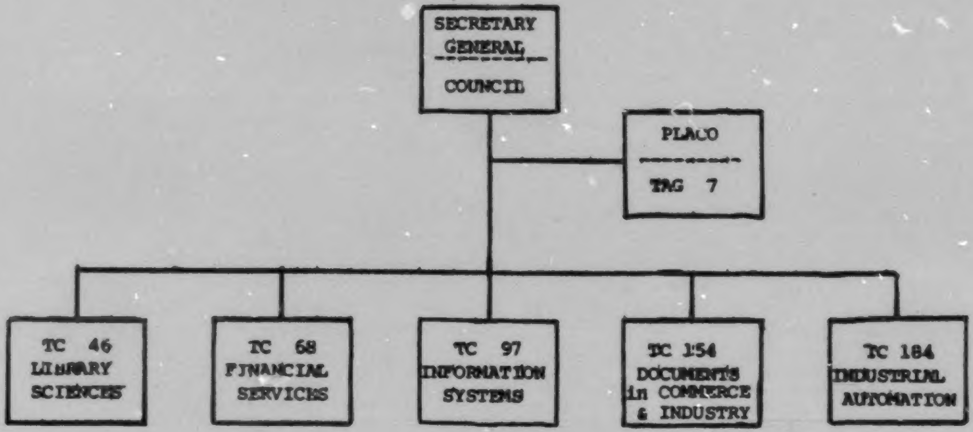
SECRETARY
GENERAL
COUNCIL
PLACO
TAG 7
TC 46
LIBRARY
SCIENCES
TC 68
FINANCIAL
SERVICES
TC 97
INFORMATION
SYSTEMS
TC 154
DOCUMENTS
in COMMERCE
& INDUSTRY
TC 184
INDUSTRIAL
AUTOMATION

FIGURE 6 : ISO ACTIVITIES AFFECTING LAN STANDARDS DEVELOPMENT

material is covered. As the audio and visual equipment are being formulated into a system, there may indeed be some need for a new activity of integration that can be provided through TC83. If that is not needed, TC60 is the proper home for the integrated Audio-visual systems. In the ISO, Industrial Automation is covered in TC184. (Several applications are also important but probably not significant in the telecommunications orientation that we have at this conference). Other ISO Standards activities, however may be of interest. These are the "Documents for Commerce and Industry" in TC154, "Financial Services" in TC68, and Library Sciences in TC46, especially in TC68 work on a "chip card". This is a plastic card similar to a credit card or identification card in which a microprocessor chip has been inserted, providing security logic or various kinds of control logic. Many applications can come from this particular device for a number of purposes and I will not take your time now to make suggestions in this direction. They will develop.

3.1 International standardization related to LAN's

Figures 6 and 8 show the significant areas of ISO and IEC relating to LAN standardization. But the heart of our concern in these activities is the interworking of ISO/TC97 and IEC/TC83. Eventually these two organizations must develop their standardization programs so that overlap, instead of being a ever threatening danger, would normally be an exceptional type of risk. The really new area, and one whose approach is still under definition, is Home Electronics. See Figure 7. Many, many things could fit into this area but they represent a fairly diverse range of bandwidths, of duty cycles, of requirements for data integrity, and fall back capabilities. Is it enough simply to work on interconnecting all of the home entertainment devices? Is it enough to work on a way to connect all of the devices in the kitchen? TC83 is agonizing over these kind of decisions right now. Is there a possible form of interconnection that would allow a controller for the system to evaluate the communications and control needs of its components/subscribers, based upon demand rates. It could circulate tokens, for instance, at a rate to give adequate service to all of its attached subscribers. But not excess service. What are the possibilities for flexibility in this regard? Installed capacity must be capitalized; what do you do with the unused capacities, and whatever times that may exist? So, I would say, in Home Electronics

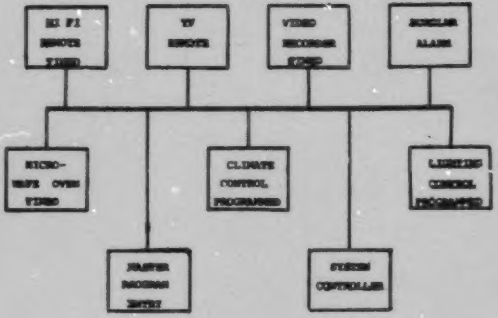
HI FI
REMOTE
TIMED
TV
REMOTE
VIDEO
RECORDER
TIMED
BURGLAR
ALARM
MICRO-
WAVE OVEN
TIMED
CLIMATE
CONTROL
PROGRAMMED
LIGHTING
CONTROL
PROGRAMMED
MASTER
PROGRAM
ENTRY
SYSTEM
CONTROLLER

FIGURE 7: HOME ELECTRONIC BUS

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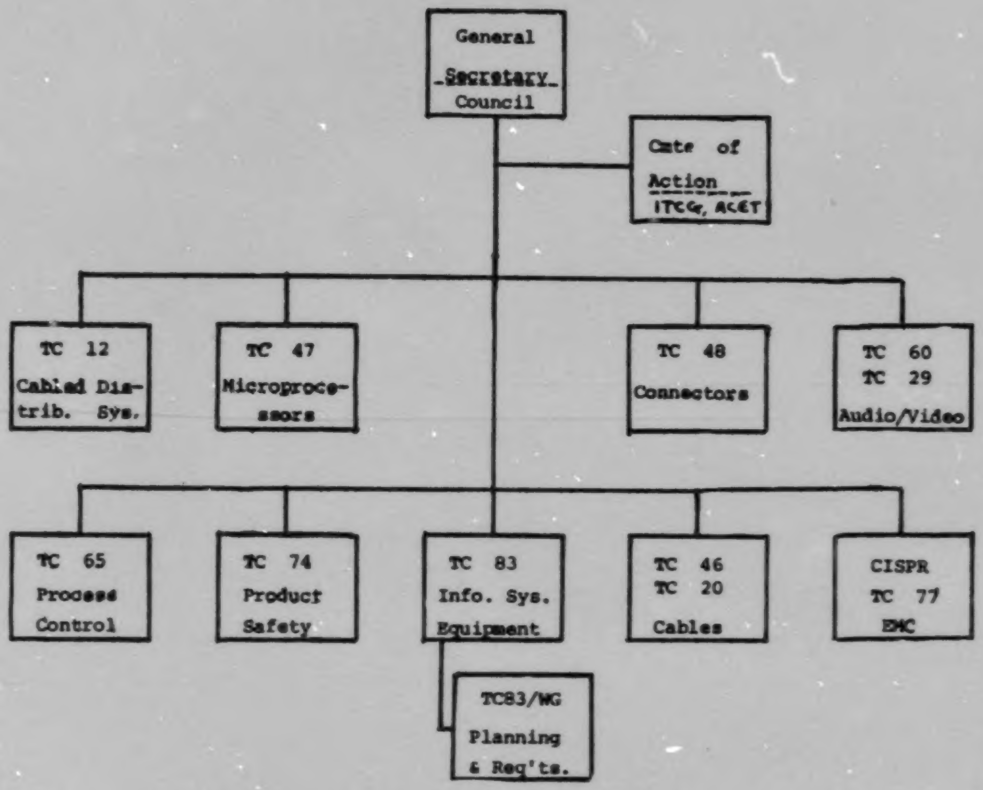

General
Secretary
Council
Cmte of
Action
ITCG, ACET
TC 12
Cabled Distrib. Sys.
TC 47
Microprocessors
TC 48
Connectors
TC 60
TC 29
Audio/Video
TC 65
Process
Control
TC 74
Product
Safety
TC 83
Info. Sys.
Equipment
TC 46
TC 20
Cables
CISPR
TC 77
EMC
TC83/WG
Planning
& Req'ts.

FIGURE 8 : IEC ACTIVITIES AFFECTING LAN STANDARDS DEVELOPMENT.

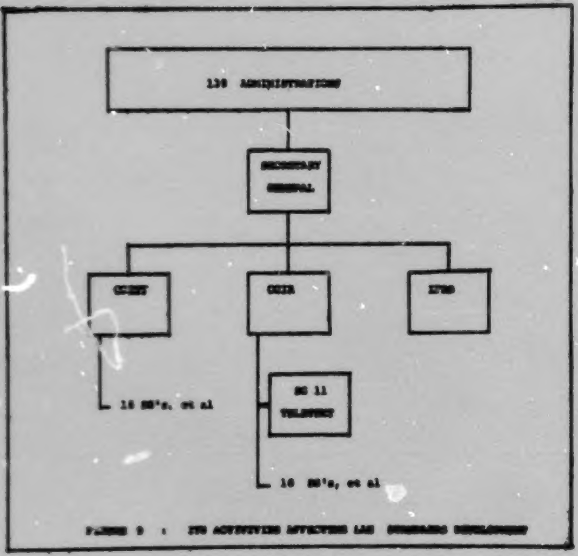
area we have entertainment; safety and environmental controls; personal computing; extensions of telematic services and household management as sub-areas of application, without a clear distinction, as yet, as to which has the economic priority and how far reaching it should be in an Home Electronics System. We could supplement this data by technical descriptions and suggestions from a number of sources, but we will limit the detail to that shown in Figure 7 at this time.

An area where ISO and IEC are cognizant of the need for standardization, is that which deals with simultaneous or at least consecutive voice and data capability, or in the area where some data is being handled on a analogue basis with modems between the work station and the communications link. And in other situations where the subscriber set digitizes the voice and all controls, all message structures, all immediate storage of voice originated material is in digitized form. There are capabilities for voice signature recognition as well as the capabilities for authentication procedures and for garbling voice security measures. The same thing would be true for teleconferencing although many people do not consider this to be a home-oriented situation.

3.2 The International Standardization process

Thus, progress in international standardization finds ISO and IEC able to support each others' programs in Information Systems technology, extending the coverage to private systems and process control applications.

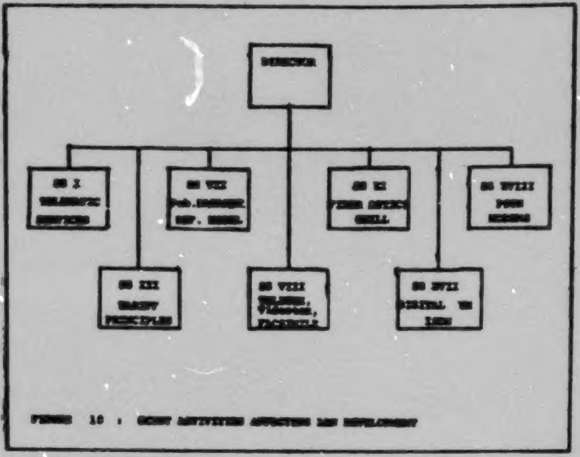
Last but not least by any means, is the manner of operation of ISO and IEC and their several national member participation parties. Once the need for a standard exists, proponents have infinite impatience. They want the standard to pop out instantaneously, yet they want universal consensus as to its content and acceptability and instantaneous dissimenation of the approved copy. The ISO and IEC management are not only aware of the utter impossibility of the ideal conclusion being requested here but they are also aware that they can do much toward achieving at least a



partial fulfillment of those goals. Automation exists at this time in the ability to word-process the text of a standard, to make editorial revisions in an orderly way, as approvals generate comments, and as ballots indicate the need for change. The status of a standard, a managerial type of task, has also been achieved in terms of project registers and project time table catalogs; and automatic "people" files and many other management-type of features for recognizing the need for attention to procedural matters. There are examples in IEC of how rapidly this works; there are examples between French and American ISO sub elements of their national bodies producing an exchange of textual material between Rapporteurs. There are examples of meetings being conducted in which one of the assistant secretaries is actually operating a keyboard and entering decisions, resolutions and modified text onto the data base as the meeting progresses.

I would characterize this as healthy experimentation, refinement of proven feasibilities, but not yet a standardized automated procedure. That will be coming in a few years and represents potential appeals in the way documents, standards will be sold in the future. It will have a tremendous impact on translation, on national vs. international document sales and on the size of the major Secretariat bodies. On the technical side, the need to provide better alignment of the Technical Officers with the areas of standardization and to have them more generalists to follow the entire standards range of committee work from national responses through publication phases at the Central Office. There are changes in the quality and nature of the people that will man the Secretariats.

Automation, being a few years away, represents in those few years the need for capital to acquire and front-end expenses to debug these new automated systems. This expense starts with a uniform specification to which our systems can interconnect, be it a local or standard data comm interconnection. Various conventions in data elements, control signals for word processing and the like, are all part of the need to have optimum operating efficiencies of these several systems. Standards are probably the cheap way to arrive at this kind of commonality and better harmonization of the cash flow time line because of the need to acquire capital and need to acquire approval of decisions to automate and to make capital expenditures, and to reassign those personnel, who are now doing manual drudgery, into more productive work, (not necessarily in the same agency as before).



3.3 ITU activity re LAN's

Among the Treaty Organizations involved with Standardization affecting the Information Industry, the ITU is the most important. Figures 9 and 10 identify the pertinent action in the ITU and its key organs. The CCITT's interconnection activity I think is well in hand and the technologies and the services should be available to cope with the needs. Cooperation between CCITT technical elements (i.e. Study Groups, Working Parties, Rapporteurs and corresponding technical elements in ISO and IEC is very good.

I tend to avoid discussions of the CCIR in this area mainly because one way broadcast implications are not that clear to me at this moment. It is possible that there is adequate market for transmit only broadcast type services for teletext. It is also possible that reverse channel narrow band earth station type of interconnection, rather than conventional video broadcasting, could provide the proper need. However, those applications are a bit more distant than what we can cover in todays paper.

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4. IMPACT ON THE PACIFIC AREA COMMUNITY

In paragraph 2.2 we have described some of the characteristics of different LAN's and we have shown that the interconnections between them are amenable to microwave links (although it is very expensive) and to certain satellite channels. In the CSMA type of arena, Aloha Net has a great affinity to this kind of intercommunication. These features are but two that match the kind of dispersal capability that LAN's have.

The Pacific Basin, being characterized by numerous islands in a single economic infrastructure; by land-water configurations with rugged topography and with related entities which are widely separated, needs unique telecommunication linkage to handle information functions. That is, wire and low powered radio have limited utility in this environment.

A second major characteristic of the Basin is the low traffic on any particular service in many areas. Such low traffic cannot justify major telecommunication information systems investments. These investments will be made when traffic does build up enough. LAN, Home Bus, and ISDN are means now available to mix the several services on specific telecommunications facilities. (Packet switched services and various other time division multiplexing (TDM) schemes can also be helpful). Topography fails to provide line of sight communication between two subscribers seperated by an ancient lava flow - and not much distance, if one could burrow through the lava. Means of interconnecting those two points with a third point that is intermediary, and stringing this kind of an arrangement in some more complex arrangement can be a LAN loop. Normally the expense of doing this for each and every point needing communication cannot economically be justified; in fact, it seldom can without multiplexing services. But when traffic rises high enough, then the justification is very easy to achieve.

4.1 Pacific topographic considerations

To tie together many of the services that now exist in a spasmodic way in certain parts of the Pacific Basin, the techniques coming forward from CCIR on broadcast telematic services, and the ISDN from CCITT will provide a basis when coupled with the experience of local problems to find a way to attach a delta requirement unique to the Pacific, but utilizing all of the work of the general LAN capability should be particularly helpful. Consider a collection of islands as shown on Figure 11. That is of course one characteristic of the topography of the Pacific Basin as we mentioned above.

Location A, an industrial complex such as a sugar mill might have need for several dozen subscriber stations, all needing voice, plus some also needing data service. Similarly, the resort E and the hospital H would have similar kinds of needs. The city B and the Seaport C have similar needs, but with many more subscribers, while the estate G, the fishing village D and the transmitter F have very few subscribers. The rugged terrain makes stringing conventional wire circuits difficult and expensive. There is some need for high bandwidth entertainment (TV) and some interconnection to networks beyond this island. LAN's offer higher bandwidth facilities shared by many subscribers using many different services, thus increasing traffic to an economic level. While ordinary multiplexing of voice circuits could get the same bandwidth, efficient mixing of different telematic, video and voice/services would not be achievable.

The topography is such that few lines-of-sight exist: e.g. B to C is ok, but B to A or C is impossible because of the high terrain. Running circuits from A to J to B, even though J generates little traffic on some services, may be economic on a multi service wide band connection (ISDN) between the major communities, and by LAN within each community.

The remote island may have some line-of-sight paths to the principle island - but only on the side facing it. The far remote island has no such opportunity due to curvature of the earth. Today's technology makes a satellite very attractive compared to Tropo Scatter transmission for multi-service and wide band width needs.

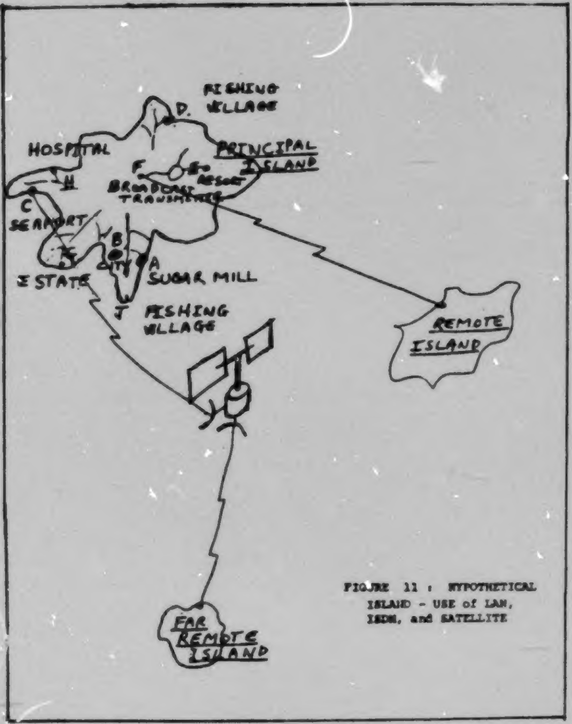

FIGURE 11 : HYPOTHETICAL ISLAND - USE of LAN, ISDN, and SATELLITE

4.2 Pacific Traffic Considerations

PTC as you know have had a mid-year meeting as well as a major conference in '83 in New Zealand. We talked about thin routes, low traffic problems and economic telecommunication means to provide service in this environment along with the great geographic dispersal in the Pacific. The impact of that thinking translated into the LAN area indicates that we must be able to provide service in an economic way for low traffic and for rather sophisticated services in an economic way even though they are used relatively sparingly. Communications systems always become economically efficient when they are running with the duty factor high enough to make the system seem busy but not so busy so that there is periodical or even complete blockage. What this means in the case of thin route environment is the interactivity of several kinds of traffic onto the same communication paths instead of having independent network for data only, a seperate network for voice, a third network for broadcast and high quality audio and a fourth quality for video, it is necessary that we are able in some manner, provide for service of all of these different applications onto one mediuim. One way that this can be helped is by digitizing voice and by digitizing video. In this manner, bit streams can be achieved with those bit streams interleaving single or groups of bits, depending on the requirements for bit rate and data integrity required. This would be achieved and a frame established on multiplex basis for these many kinds of traffic. Nor should we forget that secure voice and store and forward voice can augment ordinary two-way direct interactive speech. It can be handled by teleconferencing which is multi media in itself, and slow scan video are adaptations that could help provide communication channel sharing. It is premature to attempt a specific suggestion for what ratio each of these services should take on such a shared medium. It is sufficient to say that most data needs in the Pacific Basin could probably be handled without increasing the cost of the system or conversely that substantial video could be achieved if the data system backbone were to be installed based upon need for data traffic in various kinds of business systems.

4.3 Examples of unique application situations

We have heard, from case studies submitted by the Australians and the Chileans at previous conferences, how the topography of their respective countries require solutions that are different than the island communities or than the metropolitan densly populated areas of say Western United States or Japan. Bearing in mind those kinds of topographies, we would tend to introduce still another that has not yet been actively described in the PTC: that of the vast land masses such as you might find in Brazil, Siberia and China. As the most likely and proper candidate for our community, we should look at China and see that there are mixtures of all the topographies that I have talked about before: Regions of sparse population, formidable geographic barriers to line of sight communications, extremely dense urban situations, traffic density variation and gateway problems. UN studies relative to Brazil and India made a number of years ago on the basis of satellite and earth station configurations would be useful in this regard as well, but those were for the sake of ordinary voice communications, possibly of second priority with governmental dissimenation being the first. We must now consider from the standpoint of what we are covering here that commerce, education, business, entertainment should have high priority and that have the best return on investment before the expense to install and operate the Information Systems we are talking about.

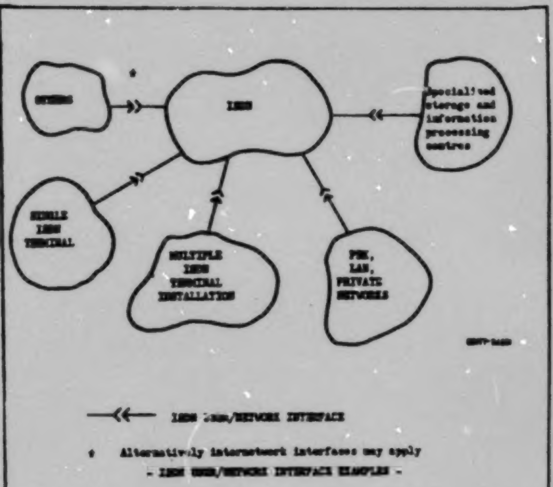
NETWORK
*
ISDN
Specialized storage and information processing centres
SINGLE ISDN TERMINAL
MULTIPLE ISDN TERMINAL INSTALLATION
PBX, LAN, PRIVATE NETWORKS
ISDN USER/NETWORK INTERFACE
* Alternatively internetwork interfaces may apply
- ISDN USER/NETWORK INTERFACE EXAMPLES -

Figure 13. Illustrates the interconnections of ISDN with various dedicated networks

4.4 Telecommunications Facilities for these situations

In Paragraph 2 we mentioned that Burroughs had made a LAN specifically to interconnect to disparate networks and that ISDN would in turn be developing some standards for the common side of such inter-network interface. This is shown by the accompanying Figure 12 (CCITT 54201) taken from Study Group XVIII's Document R15, a report of their meeting in Kyoto last February. The ISDN would have access at 64 kilobits per second or either 1.544 or 2.048 megabits per second capabilities and have responsibility for network synchronization and for control as well as customer traffic data flows. See Figure 13. To what extent these interfaces would be necessary and some of the early Pacific Basin opportunities isn't clear. I would think that following the sustained

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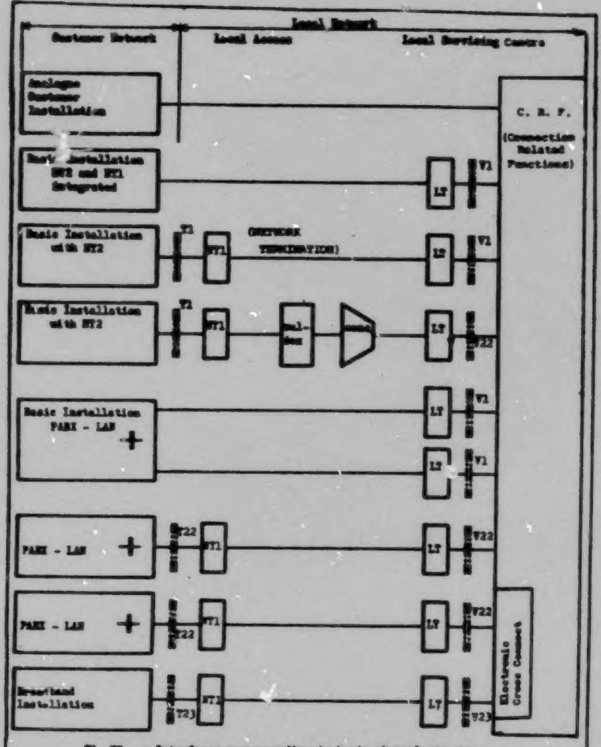
development of ISDN recommendations, which will probably continue well into the next study period, that suppliers would be basing their offerings of custom interfaces upon the work done in Study Group XVIII, and it's supporting Study Groups, at least for the next 5 to 10 years. Figure 13 sample service and equipment connections to ISDN centres.



T1, V1 : Interfaces corresponding to basic channel structure
T22, V22 : Interfaces corresponding primary rate channel structure
T23, V23 : Interfaces corresponding to a broadband channel structure

Note : All these configurations are not mandatory to be implemented in a given network.

[3418] Figure 13 ; Examples of practical local arrangement

CCITT-42960

5. RELATION TO BROADCAST

Satellite capabilities in the Pacific have been described by Japan and by Comsat in previous case studies. The merits of these kinds of services for quite conventional applications in telecommunications are described in those studies. A satellite can operate as a contention point in a time division or carrier-sensing type of system. Therefore, the adaptation of certain linkage and transponder capabilities would be a natural fit for the LAN carrier sensing architecture. It could also be a node or gateway of a token bus. Where satellite communications is an inherently appropriate and superior form, say for voice distribution, it should also be extremely valuable and helpful in Information Systems use involving land type of intercommunications. The Satellite home transponder would carry a token station address that might reoccur "around" a logical ring at many locations - even as every other "station". The other glamorous type of medium coming onto the horizon is the fibre optic system. This system requires direct and unbroken physical connection; however, it does provide isolation and electrical integrity from intercept and random interference generated by environmental factors. It also has some affinity in relationship to direct optical paths, which later on might be very useful on limited distances in the Pacific environment.

In an economy where television sets in every home or office or business establishment is more nearly the rule than the exception, teletext offers a great deal of capability and benefit because the investment of that set need not be repeated when one acquires a full Work Station or broad application Receiver/Terminal. However, in the dense populated areas where those criteria would seem to pertain we have also the fact that probably the use of that TV set for entertainment would consume too much of the duty factor, too much time to permit much application for personal computing or buying or booking travel. So in that particular segment of society where we have enough sets, and those sets have enough spare time, teletext can have a substantial utility. When one compares teletext to videotex and the ability of the latter to provide a return channel, then one starts to see another serious limitation of teletext. However, the responses in teletext are relatively narrow bandwidth and they could be conceived that a narrow band channel operating through a conventional telex, even ½ speed telex, to one collection point and then a relay to a satellite link would be a way to make teletext effective again.

While CCIR does not claim this kind of service (i.e. return chanel) and are probably are not studying too much about it, I feel it is a form of the teletext that can be very useful in the Pacific Basin.

Lastly, I will mention the fact that many of the carrier sensing systems for general application utilize twisted pair for cheap inside the premises wiring. Our description in Sect. 2 emphasized coax-75 ohm-cable. Usually coax is used because of a few other things being put on it or to gain a little bit greater bandwidth without changing the basic logic of the access leads. When the data rates are right, however, the format of this cable including all techniques used for telegraphy still have some merit and can provide an interactive service of low duty factor that may have a peculiar application benefit in the Pacific whereas it would not be very beneficial in a large automated office.

6. ORGANIZATIONAL CHANGES IN STANDARDS WRITING BODIES

Last year I spoke of a number of devices that

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are being contemplated within ISO/TC97 for improving its operation. Those items continue under study and some of the principles are being implemented as pilot operations. I can say that the planning function and the "Rapporteur or Editor per DP" are proving to be very effective management tools.

Let us look into the several places within the IEC for Information Systems work which has been going on. The Committee of Action established (in 1982) the IEC/ITCG - the Information Technology Coordinating Group. It discovered action in IEC/TC29, in TC47B, in TC65C, and also in TC60, all bearing upon the information technology. It recommended an Information Technology Equipment Committee and a broad charter was given to TC83. This TC has not yet established any work program. ISO pointed out to IEC that much overlap in the statement of charter could exisit between TC83, the other TC's of IEC mentioned above, TC97 of ISO and several other TC's of ISO as well, and that there could probably never be words chosen that would be mutually exclusive between two such committees. The PLACO of ISO appointed a technical advisory group to itself called ISO/TAG7 to look into matters of overlap and interaction within ISO and between ISO and IEC. I serve on ISO/TAG7; we have met once with the IEC folks and several additional times alone, pointing out where these overlaps were more specifically and developing with IEC a procedure to establish in an orderly manner new work in either committee. When there seemed to be a conflict or a competition for the work, an appellate procedure, up through the Secretaries General, to resolve this kind of assignment was devised and agreed. As yet no such new work items have appeared that require such resolution. Once enough work has been undertaken in IEC/TC83, and closely related work currently assigned to another TC is reallocated, it is likely that the basic function of ITCG will no longer be needed. But until such a day arrives I would expect that these two coordinating bodies would be able to settle most matters both of advance planning and of arbitration so as not to need general secretariat intervention.

Each body is also charged with coordinating within its own international organization, including the managerial and administrative procedures that go with this activity. Like most good watchdogs, when they prowl and start to wag their tail, they usually are able to achieve the results expected of them without biting.

The present structure of TC97 is shown on Figure 14.

Within ISO/TC97, work has continued to grow and new work items have been dumped by and large into the most suitable existing Technical Committee or SC. Reasons for doing this include the desire to not proliferate the infra

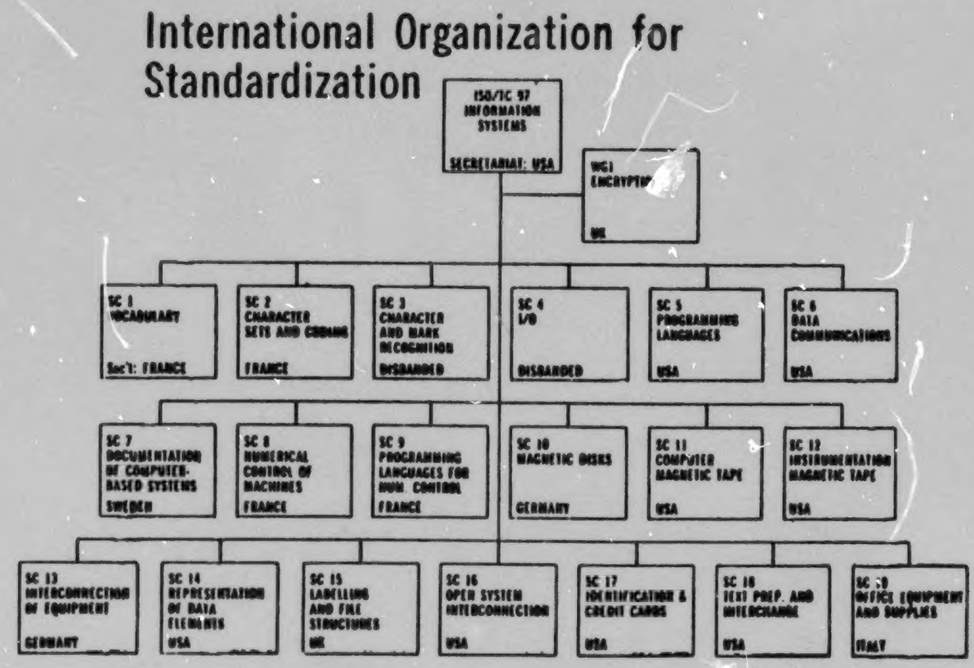
International Organization for Standardization
ISO/TC 97 INFORMATION SYSTEMS SECRETARIAT: USA
WG1 ENCRYPTION UK
SC 1 VOCABULARY Sec't: FRANCE
SC 2 CHARACTER SETS AND CODING FRANCE
SC 3 CHARACTER AND MARK RECOGNITION DISBANDED
SC 4 I/O DISBANDED
SC 5 PROGRAMMING LANGUAGES USA
SC 6 DATA COMMUNICATIONS USA
SC 7 DOCUMENTATION OF COMPUTER-BASED SYSTEMS SWEDEN
SC 8 NUMERICAL CONTROL OF MACHINES FRANCE
SC 9 PROGRAMMING LANGUAGES FOR NUM. CONTROL FRANCE
SC 10 MAGNETIC DISKS GERMANY
SC 11 COMPUTER MAGNETIC TAPE USA
SC 12 INSTRUMENTATION MAGNETIC TAPE USA
SC 13 INTERCONNECTION OF EQUIPMENT GERMANY
SC 14 REPRESENTATION OF DATA ELEMENTS USA
SC 15 LABELLING AND FILE STRUCTURES UK
SC 16 OPEN SYSTEM INTERCONNECTION USA
SC 17 IDENTIFICATION & CREDIT CARDS USA
SC 18 TEXT PREP. AND INTERCHANGE USA
SC 19 OFFICE EQUIPMENT AND SUPPLIES ITALY

FIGURE 14 : Present Structure of Information Systems Standardization in ISO

structure, making management even more difficult; increasing Secretariat expenses at national and international levels; and spreading the existing community of qualified chairmen and Secretariats even more thinly. A result of this is some projects have gotten lodged in the wrong location and some Committees have had a motivation for new work, their own perpetuation rather than the user-driven series of requirements that are acceptable. With this in mind the Advisory Group to TC97 appointed a special Panel last February in Boca Raton which has reported back last month to the Advisory Group. It has recommended a restructure which creates three Vice Chairmen of the TC97 and organizes the Information Processing Systems Grouping into three Application SC's and four Functional SC's.

The several existing projects are grouped in a more logical way; generic modelling is expanded (i.e. not just the OSI Reference Model); and a few new systems tasks are added.

These recommendations of the Panel are shown on Figure 15 and 16.

A number of sub committees of TC97 now are oriented toward application elements and toward equipment and these areas are recommended to be split from the systems-oriented TC. Possibly TC83 of IEC and the equipment spinoff of ISO/TC97 could at some point merge.

This proposal is still being considered and it would be improper if I attempted to do more than describe it. I describe it for the purposes only of indicating a trend in thinking, and how reorganization will help get

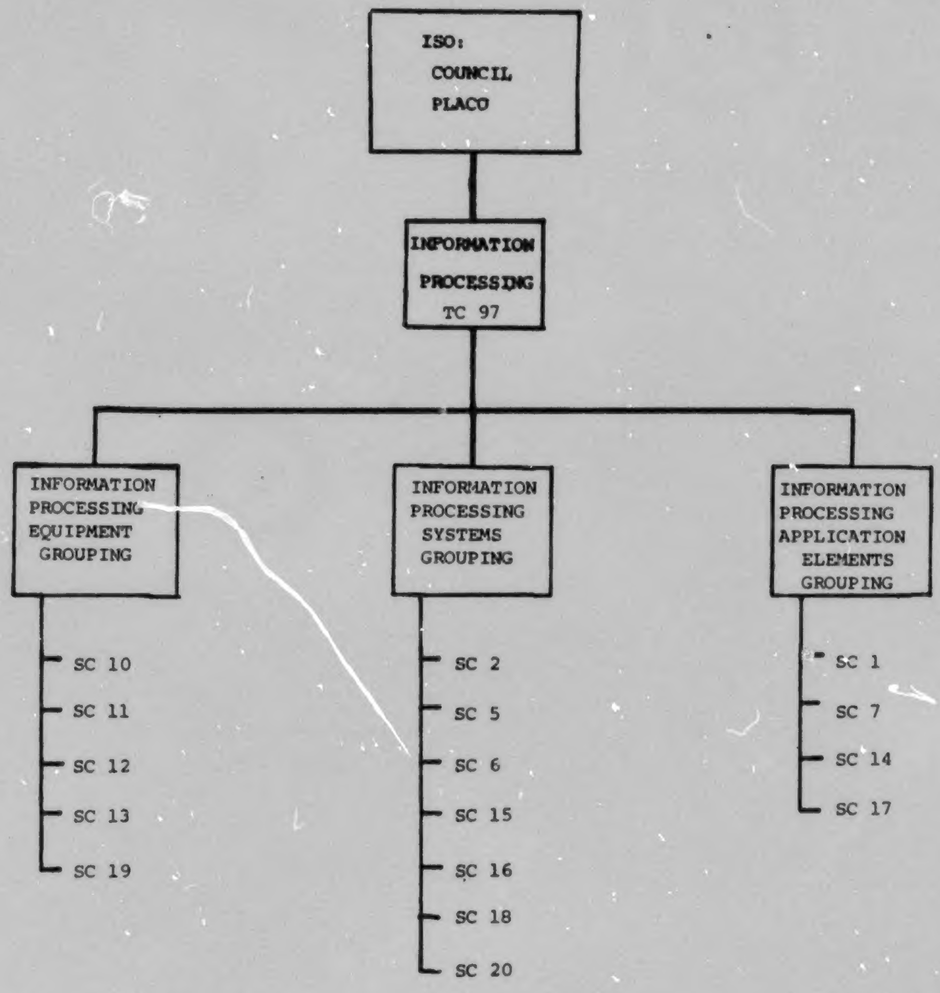
ISO:
COUNCIL
PLACO
INFORMATION PROCESSING TC 97
INFORMATION PROCESSING EQUIPMENT GROUPING
INFORMATION PROCESSING SYSTEMS GROUPING
INFORMATION PROCESSING APPLICATION ELEMENTS GROUPING
SC 10
SC 11
SC 12
SC 13
SC 19
SC 2
SC 5
SC 6
SC 15
SC 16
SC 18
SC 20
SC 1
SC 7
SC 14
SC 17

FIGURE 15: DRAFT RESTRUCTURING PLAN FOR ISO/TC97 (as of Oct 1983)

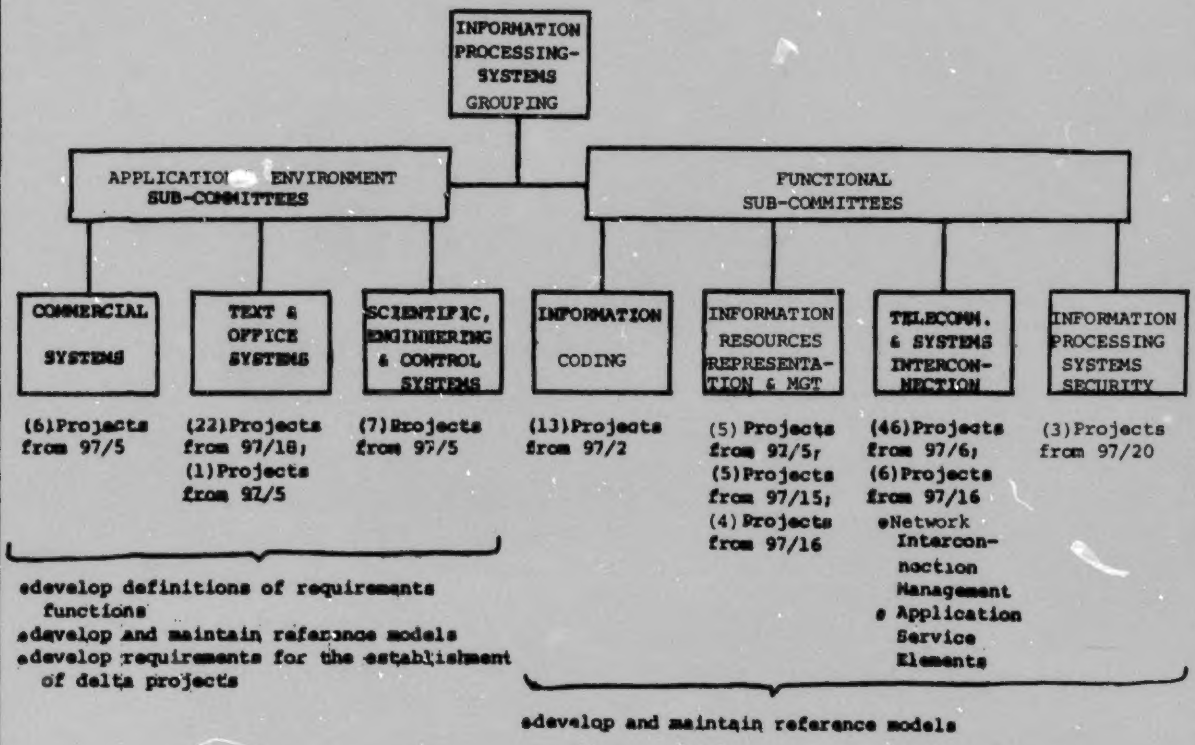
INFORMATION PROCESSING-SYSTEMS GROUPING
APPLICATION ENVIRONMENT SUB-COMMITTEES
FUNCTIONAL SUB-COMMITTEES
COMMERCIAL SYSTEMS
TEXT & OFFICE SYSTEMS
SCIENTIFIC, ENGINEERING & CONTROL SYSTEMS
INFORMATION CODING
INFORMATION RESOURCES REPRESENTATION & MGT
TELECOMM. & SYSTEMS INTERCONNECTION
INFORMATION PROCESSING SYSTEMS SECURITY
(6)Projects from 97/5
(22)Projects from 97/18; (1)Projects from 97/5
(7)Projects from 97/5
(13)Projects from 97/2
(5) Projects from 97/5; (5)Projects from 97/15; (4) Projects from 97/16
(46)Projects from 97/6; (6)Projects from 97/16
•Network Interconnection Management
• Application Service Elements
(3)Projects from 97/20
•develop definitions of requirements functions
•develop and maintain reference models
•develop requirements for the establishment of delta projects
•develop and maintain reference models

FIGURE 16 : DRAFT RESTRUCTURING DETAILED PLAN FOR PROPOSED INFORMATION PROCESSING SYSTEMS GROUPING (as of Oct 1983)

the user more standards in an earlier time frame.

7. TRADE ASSOCIATION INTERESTS

I mentioned at the outset that trade association interest in utilizing new telecommunication capabilities, such as LAN's, was perking up. There are two reasons for this: one is that the nature of the industry boundaries are being reexamined and that the common positions in standardization, in trade, and in economic means of how to produce better coordination between several national activities. It is of great concern to the people who pay most of the bill -- although the standards writers in some countries collect their money through the government -- normally funding comes primarily from manufacturers. This section of the community is beginning to speak up and attempt to get more "bang" for their buck in standardization and trade relationships. The computer and business equipment industries have been active for 20 years, but at an ever increasing level of participation. The electrical industries see themselves becoming more and more a part of communications and more particularly a part of the Information Industry, hence their awakening. The international standardization infrastructure has been around long enough to develop a sense of self perpetuation; their particular structure and operation are under examination, both by their sponsors and by themselves. Therefore I would expect to see that, through trade associations and through professional societies as well as industry, the private sector will show much more activity over the next decade in an open way than they have in the last.

8. CONCLUSIONS

We have attempted to show in this paper the impact of Local Area Networks and the brief indication of ISDN as it can influence the development of the Pacific Area Basin, utilizing some new approaches in telecommunication networks. The jist of the utilization of LAN's depends on the ability of the user to procure station equipment from varieties of manufacturers which would include manufacturers of the Information Industry; which would include a number of organizations very active in the development of LAN's; for example: Xerox, Hewlett Packard, IBM, Siemens, Phillips, Burroughs (of course), others as we mentioned in several places in this paper. These companies are committed to the basic theses that their produces would be inter-connecting with a communication LAN network, supplied by the ultimate user himself or by other parties, frequently not the PTT's.

This leads us to our second conclusion: that not only are LAN's useful, but standardization is required so that the user has his maximum flexibility for interconnection, and so that the manufacturers of telecommunications equipment are able to provide proper, uniform interfaces between the telecommunication and the information processing industry.

A third point that we have indicated is that the Local Area networks, while they can economically supply the needs of a very well defined community, also provide a means for interconnecting between different disparate networks. That Local Area Networks will exist and will serve different application needs in a variety of configurations. Standardization of the CSMA/CD and Token Rings is moving rapidly and can at this moment assure the user that he can make his interconnection commitment, his system designed commitments now.

Finally, we have attempted to show, that LAN's are compatible in technology with new telecommunication services and facilities such as the ISDN and Direct Broadcast Satellites as well as other satellite channels.

Standardization has been much advanced, and will continue to grow. Means are being undertaken to improve the standardization process so that the results will be available to the users in a timely fashion. Many features of automation will work in the area of information processing are being utilized. This permits the user, particularly the user in the Pacific Basin, to immediately start planning his projected activity and needs for these services for substantial time in the future so that he can project his growth and utilize the most effective form of these services. The challenge is great for the high urban density, for the low traffic communities and for the rugged topographical station locations. The Information Industry stands ready to extend services to these new clients and as a member of industry we thank you for the privilege of letting us speak to you today.

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10. ACKNOWLEDGMENTS

We wish to acknowledge the assistance and helpful comments from associates in Burroughs: Michael J. Bedford who is also Chairman of ISO/TC97/Sub Committee 18 and Ira R. Purchis and our associates in the International and National Standards arena, particularly Jack Wheeler and Dave Carlson of the U. S. Data Communications Standards activity; Sava Sherr of the IEEE; and Dara Hekimi of ECMA.

PROGRESS AND PROBLEMS OF THE NEW TECHNOLOGY

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1. ABSTRACT

The emergence of new technology brings to light the promise of better telecommunication functions crucial to developing countries. Its economy allows telecommunications administrations to provide more of the same basic services out of the same resources. Its versatility brings about a broader spectrum of services out of the same facilities.

The introduction of a new breed of high-tech equipment may also pose certain problems. Outstanding among these are their adaptability to existing telephone plants and the inadequate technical expertise in developing nations to operate them.

The appearance of new technology is a fact of life. After all, the equipment in service now were once the new technology equipment of before. As in the past, the telecommunications sector can cope with the problems associated with their introduction. This only requires a clear recognition of the possible problems that may arise plus the appropriate preparation and a determined effort to overcome them.

The potentials offered by advanced technology systems serve as one of the cornerstones of sectoral progress. In the Philippines, in particular, a Telecom Master Plan involving the installation of some three (3) million lines between 1983 and the year 2000 specifies provision of digital equipment.

2. INTRODUCTION

We live in a world wherein information flow is constantly taking place everywhere. Our global communication system permits an interchange of information where time has continuously ceased and space has rapidly vanished. The world has become smaller.

At the root of these changes is the current technological revolution which has created highly sophisticated equipment and services. This revolution is opening more portals to a faster, more progressive world of commerce and industry and is bringing higher efficiency into our homes. Ours is a generation that is witnessing the evolution and realization of sophisticated telecom services that once existed only in the fantasies of our forefathers.

New services like videotex, facsimile, electronic mail and video conferencing have caused the creation of a new environment appropriately termed the advanced information society. Facilities like fiber optics and digital switches have brought to light the promises of faster and more reliable forms of communications.

3. BENEFITS FROM THE NEW TECHNOLOGY

Indeed, the emergency of the new breed of equipment and services opens a whole new episode of opportunities for the telecom sector especially in third world countries. It provides some encouraging options in service provision strategy. It presents itself as an attractive solution to the ills and contraints besetting these financially-inadequate nations. Some of the beneficial effects of the new technology systems are outlined below.

3.1 ACCELERATE ECONOMIC DEVELOPMENT

The new equipment and services evolving from the new technology respond to the need for faster and more effective ways of communications critical in decision making process at all levels - national, corporate, and personal. Some of these new services, for example, are abbreviated dialling, push-button dialling, call transfer and direct-distance dialling. They reduce the time alloted for transaction and, therefore, expands the time available for more productive affairs. More significantly, the rapid transfer of information resulting from their application allows for more efficient trade and commerce and, consequently, improve the allocation of resources.

3.2 MORE FACILITIES

Equipment based on the new technology promises to be more economical than the conventional facilities they intend to replace. On a per line basis, the new switching systems cost substantially less than their previous counterparts. Tremendous improvement in satellite and fiber-optic technology is causing a drastic drop in transmission costs which enables telecom administration to simultaneously undertake service improvement and enlargement of the network.

Wide scale integration of components has also reduced the space requirements and installation time needed for various facilities. New building construction has in some cases become unnecessary since existing ones, constructed in accordance with the space specification of old technology equipment, can readily accommodate more of the latest versions of equipment. Land-based transmission systems have diminished considerably in diameter with fiber optic system causing the postponement and even elimination of conduit network expansion which, aside from the enormous financial resources it requires, also, possesses some unquantifiable external diseconomies in the nature of inconvenience it presents to the public.

3.3 MORE SERVICES FROM THE SAME FACILITIES

The new technology today offers a new dimension of varied services utilizing the same facilities. The telephone of a subscriber can now be equipped with different features to make it more efficient. With the upcoming Integrated Digital Network (IDN) various terminals may also be hooked into the public switched network eliminating the requirements for dedicated leased lines where utilization of such lines is below optimum level.

3.4 BETTER NETWORK PERFORMANCE

With computer-controlled operations and maintenance center, the whole network is better monitored to assure stable and reliable performance. The maintenance concept has drastically changed from decentralized to a centralized one, thus making a more effective use of highly trained personnel in solving network problems. To have a balanced network performance, the old equipment and facilities have to be rehabilitated in order to improve their operating performance.

3.5 BRINGS DOWN THE LANGUAGE BARRIER

The new services emanating from the latest in technology also offer an answer to the underlying problem of language differences which has hindered international cooperation and transaction. Using the visual component of communications, matters which cannot be expressed orally can be presented in visual formats thereby enhancing better understanding.

4. PROBLEMS WITH THE NEW TECHNOLOGY

Telecom administrations have a great deal to gain from the new technology equipment. In the context of developing economies, however, these administrations face some potentially serious problems in introducing them.

4.1 VARYING OPERATIONAL SPECIFICATIONS

Development of advanced equipment is usually conditioned by the specific requirements of the developers' home market. Therefore, equipment which are conceptually similar and serve the same purpose may end up having different operational specifications. For a developing country, therefore, choosing among various equipment is fraught with great uncertainties and is potentially costly.

A case in point are the PCM Systems. Before, PCM has been considered as an economically and technically superior substitute for cable systems in the long routes. Administrations in the third world, eager to take advantage of these favorable features of PCM, would have been compelled long ago to subscribe to the 24-channel device due to their earlier appearance in the market compared to the 30-channel version. With emerging concept of Integrated Digital Network, the transmission system becomes an important component of the whole network. If the administration decides in favor of the 2 MBPS alternative and starts reconfiguring its trunking along the 30-channel PCM system, then, it will be faced with having to maintain expertise and logistic in both 24- and 30-channel systems.

4.2 INTERFACE STANDARDS

Interface specifications will also tend to be prescribed in accordance with the networks of countries where new equipment are developed. Their absorption by the networks of other end-users may, therefore, require extensive modification in either or both the existing and the new facilities and such modification may require enormous investment which may negate the economic advantages of the new technology equipment.

Although the existence of standards will go a long way in putting some order into new equipment introduction, telecom administrations in developing countries will still meet some degree of difficulties. Operating in an environment of capital scarcity, these administrations have traditionally operated facilities at below international standards. Vintage equipment already being discarded in the more advanced countries are still being made to function despite frequent outages. The using public has generally lived with relatively poor service quality rather than pay the higher charges attendant to better service.

With the new technology equipment, however, the service norm is now dictated by the sensitivity of the equipment to be added rather than by the economic status of a country. A network laced with modern equipment would have to be upgraded considerably and provide a grade of service beyond what the populace has been used to and perhaps even willing to pay for. Replacement of an electromechanical switching equipment with a digital version in the local network sometimes may have to be accompanied with the upgrading of the cable plant. In the end, what has been heralded as an economical solution may become an expensive one instead.

Absence of interface standards adversely affect the developing countries in still another way. Due to very small requirements, these countries have to rely almost totally on importation for the various network components. To ensure system compatibility, they may have to confine their supply to a single or limited sources which tend to restrict their bargaining position in the market.

4.3 COMPATIBILITY WITH THE MANPOWER CONDITION

The latest state of the art equipment call for a dramatic overhaul of operations and maintenance philosophy. Inadequacy of capital resources in developing countries are being answered with maintaining a large pool of relatively low paid and low skill human resources. With the conventional equipment of before, this capital-substituting scheme is a workable arrangement since the simple structure embodied in these equipment require less in terms of skill. But with the new equipment of today, skill upgrading and trimmed down manpower force which do not conform to the labor force structure of poor countries become a natural concomittant.

To maintain control of the new system, the operating company in the developing countries must develop their personnel capability in system software and hardware in the long run. Otherwise, if this issue will not be addressed, then, the development of the telecommunication system will be controlled by the supplier and adviser who may have different orientation and interest than the user itself.

The dilemma facing a developing country is a real one. On one side, it is already short of skilled personnel needed to man the more sophisticated equipment. On the other side, this short supply is still being eroded by migration to other richer countries undertaking accelerated facility provision.

5. COURSES OF ACTION FOR DEVELOPING COUNTRIES

Yet, the appearance of new technology is a fact of life. What now is the "obsolete" equipment still being operated and maintained by administrations throughout the world were once the new technology system of before. If in the past, administrations have shown their resiliency and adaptability to changing technologies and conditions, they can certainly cope with similar, albeit faster, changes occurring at present. This only requires a clear recognition of the possible problems that may arise plus the appropriate measures and preparation and a determined effort to overcome them.

5.1 It may be more appropriate for developing countries to proceed with extreme caution and employ better planning in introducing the latest state-of-the-art technology. Such introduction should be implemented with proper recognition of the prevailing human resource capabilities and network conditions. Instead of adapting the existing expertise and capability to the new equipment to be installed, the latter should be made to adapt to the former.

5.2 At the same time, third world administrations should prepare the network to conform to the rigid requirements of the new equipment. Since apperance of these equipment is becoming as much a part of reality as the prevailing economic and social conditions of a developing country, a blending of the two is inevitable. A gradual upgrading of the network as well as radical changes in the maintenance concept are in order.

5.3 Training of manpower should be given more attention. This can be undertaken in two ways:

- Intensification of in-house training activities; and,
- Participation in training courses established by various international institutions dealing on telecom matters and the telecom administrations of the more advanced nations of the world.

5.4 Collectively, the various telecom administrations of the world should strive to set standards for equipment interfacing and operational specification. Participation in this effort by the third world nations is especially encouraged so that their socio-economic conditions can be properly considered. The sooner such standards become available, the sooner will developing countries be able to harness the benefits bestowed by the new technology.

6. NEW TECHNOLOGY IN PHILIPPINE TELECOM DEVELOPMENT

In recognition of the potentials offered by advanced technology systems, the Ministry of Transportation and Communications of the Philippines has developed a National Telephone Plan and has enunciated some policy guidelines which set the stage for the adoption of high technology equipment.

6.1 The National Telephone Plan covers the period 1983 to the year 2000 and calls for the provision of three (3) million lines. An outstanding feature of the Plan is its prescription of digital equipment for facility provision.

The Plan is structured into three (3) phases as follows:

	Period	No. of Lines
Phase I	1983-1990	557,500
Phase II	1991-1995	1,070,500
Phase III	1996-2000	1,463,000
		3,091,000

The program for the first phase has been approved by our government during the early part of 1983. It covers the Metro Manila Area and two hundred twenty-five (225) other cities and municipalities classified as Major Urban Centers and Key Development Centers with estimated demand of five hundred (500) lines or more. These areas are distributed into four (4) regional groupings.

6.2 Among the more prominent policy guidelines, the direction of sectoral developments are as follows:

- Specification of digital systems and other advanced technology for new facility addition;
- Establishment of a uniform 2.0 MBPS standard for switching and transmission;
- Stipulation of a coherent strategy for a national data communication service development; and,
- Integration of operations of domestic record carriers as a step in service and facility integration.

VIDEOTEX, TRANSPORTATION AND ENERGY CONSERVATION

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1. ABSTRACT

Investment in a community videotex system may be a more cost-effective way to reduce traffic congestion, gasoline consumption, air pollution and parking problems, than building, operating and maintaining new mass transit systems and additional highways, bridges and parking facilities. Videotex offers a way to reduce the need for travel, by providing stop-at-home, tele-banking, electronic publishing and tele-conferencing services. It also offers a way to improve the efficiency of existing transportation systems by furnishing instant information on the availability of transit, paratransit and ridesharing vehicles. Equally important, videotex provides the technology necessary to develop a low-cost, door-to-door community parataxi system, which would increase the mobility of all citizens, including the aged and handicapped, and provide many full-time and part-time employment opportunities.

2. BACKGROUND

Mass transit systems and carpools are making an important contribution to energy conservation. However, it is doubtful that this contribution will increase in the future. Although public transit systems received billions of dollars of federal and state aid between 1969 and 1979, the percentage of commuters who use rail and bus services decreased from 10 percent to 6 percent during this period. This is a 40 percent loss in transit's market share during a decade in which there were two gasoline crises and the cost of owning and operating an automobile increased dramatically.

During this same decade, despite an extensive program to encourage carpools, there was an overall increase in the use of single-occupant automobiles for commuter travel. After examining the result of one carpool promotion campaign, Honolulu columnist Lois Taylor concluded that "carpools are like broiled liver - cheap, good for you and unpopular. To date, despite bumper sticker propaganda to the contrary, they don't work for most people."

Some conservationists may question the preceeding statements about the limited energy saving potential of both carpools and mass transit. It should be noted that these conclusions were developed by both Dr. Alvin Alm and Dr. Daniel Yergin in their studies of U.S. transportation-energy problems during the mid-1970's.

3. STATEMENT OF THE PROBLEM

The following statement was made by Dr. Martin Wohl, Professor of Transportation System Planning at Carnegie-Mellon University and one of the authors of the RAND Corporation Report, "The Urban Transportation Problem":

> The goals of urban transportation are so often viewed as reducing downtown traffic congestion, improving suburban-to-downtown commuting, and "getting people out of cars into transit." We look too little at the ultimate purpose, which is fast, efficient transportation. The most talked about "means" for reaching our goals usually include the construction or extension of suburban rapid transit lines as well as subsidies for new and existing facilities, transit fare reduction (if not free transit), the banning of automobiles in the downtown area, parking fee surcharges, and congestion tolls for autos. This kind of rhetoric rarely gains us more than heavy capital commitments for new or extended transit lines, new but still conventional buses or rail cars, and heavier transit deficits. Traffic congestion is not reduced; transit service seems little better - at least for most urban dwellers - and the problems of pollution, noise, and energy consumption remain unabated.

In 1970, our national bill for imported oil was $3 billion. In 1978, it was $42 billion. In 1980, even though conservation efforts and the recession significantly reduced the volume of oil imports, the price for these imports exceeded $80 billion. This is equivalent to every family of four sending $1,600 out of this country every year, and it is a major reason for inflation and balance-of-payment problems in the United States.

The transportation sector uses approximately half of the oil used in the United States and the private automobile consumes over half of this amount. The American car alone consumes one-ninth of all the oil used in the world every day.

The improvement in the mileage efficiency of the automobile population will make an increasing contribution to the U.S. energy conservation program. To make a similar contribution in our transit systems, it will be necessary to broaden our concept of ridesharing to include non-computer travel and vehicles operated for a profit. It will also be necessary to broaden our concept of public transit to include a variety of new, innovative transportation services.

4. GENERAL METHOD OF APPROACH

Because of the continued dependence on imported oil, the increasing transportation and environmental problems and the proposed federal cutbacks in operating subsidies for transit and carpooling operations in the U.S., a growing number of transportation specialists are recommending that regulations also be changed to permit individuals to use their own personal vehicles to supply local transportation services on a quasi-business basis. Unlike carpools and vanpools, which must be operated on a not-for-profit basis, the proposed "para-private" transportation services would generate income for driver-owners. This approach could add enormous transportation capacity at little or no additional cost to the public. Dr. Ray Mundy, Professor of Marketing and Transportation at the University of Tennessee, and the person who coined the term "paraprivate" transportation, offers the following commentary:

> Management of public transportation systems in the 1980s will be a major challenge for urban areas. Their operating scenarios, financial support, and general feasibility will be severely tested. The present heavy subsidy of transit is not expected to continue. Just as much of the U.S. industry has had to specialize its product offerings in a competitive market place, so will transit systems. This will mean the expansion of paratransit activities and the inclusion of paraprivate transportation options.
>
> ...How these newer, specialized forms of public transportation alternatives are integrated into existing traditional transit operations will be the major managerial and official focus for much of this decade. Those areas that are successful in broadening their concept of public transportation to include these innovations will breathe new life and vitality into their local transportation systems. Those who do not will continue to teeter from one financial crisis to another.
>
> Clearly, public transportation officials at all levels need to ask themselves, "What are we trying to do?," and restructure to accomplish these goals. We can no longer continue to use nineteenth-century work rules and early twentieth-century technology as we stumble toward the twenty-first century.

5. DISCUSSION

The microcomputer, a prime example of late twentieth century technology, provides some new tools to help public transportation officials integrate transit, paratransit, ridesharing and paraprivate resources into a more cost-effective, more energy-efficient transportation system. Low-cost videotex terminals provide a unique capability to rapidly match would-be riders with would-be drivers on a trip-by-trip basis. The objective is to create a parataxi system that combines the comfort and convenience of the taxi with the economy and energy conservation characteristics of the carpool. AUTO-RIDE is the name given to one parataxi approach developed and analyzed by the authors.

Videotex is an easy-to-use, two-way consumer information delivery system. Users in homes, offices and shops can call information from a variety of remote sources and display it on an ordinary TV set using a low-cost, microcomputer keyboard. The information carrier can be either a telephone line, TV cable or a radio link. Once installed in a community, a videotex network connects businesses and homes creating a new two-way video communications medium in which users can make reservations, purchase goods, pay bills, receive training courses and exchange electronic mail. Perhaps the most widely publicized application of this technology is the French government's program to install millions of videotex terminals as part of a program to replace printed telephone directories and reduce the cost of directory assistance services.

AUTO-RIDE parataxi system employs low-cost, easy-to-use videotex terminals to instantly collect trip requests from riders and trip offers from drivers. Because of the speed and flexibilty of the modern microcomputer, detailed trip information (e.g. origin, destination, departure time, seating) can usually be entered by pressing one or two buttons on the terminal keyboard. This information, after being checked for accuracy and completeness, is then automatically transmitted to a central computer. After careful security checks are performed, the central computer matches drivers and riders to instantly form, in effect, single-trip carpools. Confirming and coordinating messages are then transmitted back to the terminals for the drivers and riders.

It is envisioned that the AUTO-RIDE system will use a mix of professional taxi drivers and part-time drivers to provide demand-responsive (i.e. on-call) transportation services. Fares, comparable to those of existing public transit systems, will be billed monthly by the central computer. Since only a small portion of these fares will be needed to support the central computer system, most of the fares can be used to provide financial incentives for AUTO-RIDE drivers and to subsidize operators of taxi-cabs or specialized vehicles for the handicapped.

The State of Hawaii and the City and County of Honolulu are national leaders in energy conservation and in the use of both carpools and public transit. In a Bureau of the Census report that analyzed travel to work in 20 U.S. metropolitan areas, Honolulu led all cities in the percentage of commuters using carpools and was second only to New York City in the percentage of commuters using public transit. Honolulu's current ridership levels are actually higher than the long-term ridesharing and transit ridership goals of some mainland cities. Nevertheless, Honolulu has serious traffic congestion problems that are getting worse every year.

In 1975, Hawaii's Department of Transportation started a series of seminars to consider ways to limit the number of vehicles on the island of Oahu, that is, in the City and County of Honolulu. Dr. Ryokichi Higashionna, the former Director of the Department of Transportation - State of Hawaii, pointed out, at that time, that it would be unrealistic to attempt to limit the number of automobiles on Oahu until an alternative method of transportation was available to the public. Without a cost-effective public transit system, the various tax disincentives that were proposed to reduce the number of automobiles on Oahu would have placed a disproportionate financial burden on the poor. Both the State of Hawaii and the City and County of Honolulu have been conducting evaluations of a variety of transportation concepts in an attempt to develop a more cost-effective public transit system for Oahu.

6. CONCLUSIONS

During 1982 and 1983, the authors, using both State of Hawaii and Federal Highway Administration (FHWA) funds, conducted a preliminary analysis of the AUTO-RIDE concept for Oahu. The following are the major conclusions of this study:

6.1 A real-time rideshare matching system, such as AUTO-RIDE, is both technically and economically feasible for Oahu.

6.2 The door-to-door features of AUTO-RIDE are mandatory for many young, elderly and handicapped riders, and very desirable for most others. Like the taxi, AUTO-RIDE offers riders a level of service that is competitive with the automobile for both commuter and non-commuter travel. Like the taxi, it eliminates parking and driving chores.

6.3 By providing a feeder service in the more remote areas of Oahu, AUTO-RIDE can stimulate use of bus or fixed rail services. By providing convenient back-up transportation, AUTO-RIDE can also stimulate the use of commuter carpools and vanpools. On rainy days, it will also provide back up to those who normally walk or bike to work.

6.4 Videotex terminals can be used to provide current information on the arrival times of buses at any bus stop. Computerized Rider Information Systems (CRIS) have demonstrated the ability to increase off-peak ridership on fixed-route bus systems in some cities.

6.5 The terminals can also be used for a variety of "third-wave" applications, such as home-banking, electronic-mail, shop-at-home and telecommuting. These will help reduce the need for travel in the future.

6.6 AUTO-RIDE can increase full-time employment opportunities in both public and private transportation. It can also increase part-time employment opportunities for a large number of vehicle owners who are willing to provide rides to neighbors, co-workers and other qualified residents.

6.7 It can save riders money by eliminating the need for owning a second car.

6.8 AUTO-RIDE can complement and supplement existing transportation services. Its videotex terminal network can help integrate transit, paratransit, ridesharing and paraprivate resources into a more cost-effective, more energy-efficient public transportation system.

6.9 An integrated, multi-modal public transportation system can reduce Oahu's dependence on both the one-person auto and imported oil. It can increase the mobility of the transportation disadvantaged. It can also reduce traffic congestion, air pollution, parking problems and government spending on transportation projects.

6.10 AUTO-RIDE will become even more cost-effective in the future as the cost of electronic equipment decreases and the cost of building and operating conventional mass transit systems increases.

7. RECOMMENDATIONS

The following are the major recommendations of the Hawaii study:

7.1 Hawaii should broaden its concepts of both ridesharing and public transportation. Ridesharing should not be limited to carpools and vanpools; public transit should not be limited to mass transit.

7.2 Regulatory obstacles to innovative paratransit and paraprivate systems should be eliminated.

7.3 Equitable insurance arrangements and fare structures should be developed for operators of paratransit and paraprivate vehicles.

7.4 Hawaii should support the development of a prototype AUTO-RIDE system to test the concept operationally.

7.5 A complete copy of the Hawaii study, "A New Concept in Ridesharing," may be obtained from:

Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Session 3.

Economic Demand for Telecommunications as a Reflection of Needs: The Pacific Region

Forecasting of Demand
For Various Telephone Services in Hong Kong

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Hong Kong

Abstract

This paper discusses current approaches in forecasting of demand for various telephone services in Hong Kong Telephone. Short and long term forecasts are discussed together with preparation of range forecasts. The use of judgement in finalizing the forecast is also described.

INTRODUCTION

Globally forecasting in the 1960's was a less arduous task than at present since economic uncertainties were practically absent. However, with high rates of inflation, high levels of interest rates, low economic growth levels and high oil prices the likelihood of forecast deviations and the cost of these made it imperative to develop more sophisticated forecasting techniques to minimize the chance of incorrect forecasts. These developments then, underlie the development of mathematical models in the 1970's.

This paper describes the forecasting methods and models used in the preparation of various forecasts in Hong Kong Telephone. Hong Kong is very different from many territories and therefore in this volatile economic environment forecasting of telephone demand becomes rather a difficult task.

HONG KONG

Hong Kong lies on the southern coast of People's Republic of China. With a total area of about 1 060 square Kilometres it is formed by the island of Hong Kong, Kowloon Peninsula and part of the mainland known as the New Territories together with many small barren islands. With a total population of 5.3 million at present the population density is high at 5 000 people per square Kilometre.

It is administered by a Governor, appointed by the United Kingdom Government, and there is a Legislative Council and an Executive Council. As you may be well aware discussions between the Governments of Britain and the People's Republic of China are continuing on the future of Hong Kong after 1997.

HONG KONG TELEPHONE

Hong Kong Telephone was established in 1925 but its origins go back to 1882. It now has 12 600 employees, there are over 1.5 million lines and more than 2.0 million telephones with a penetration of 37.6 telephones per 100 population. There is no long distance traffic and no measured service for local calls, but international calls provide a growing source of revenue. Customers are charged a flat rate installation and monthly rentals. Over the past ten years the number of lines grew from 651 000 in 1972 to 1 477 000 in 1982 with an average annual growth rate of 8.5%.

The telephone network is fully automatic and consists of 65 exchanges some equipped with step by step and some semi-electronic. The first Digital Multiplex Switch (DMS) was cutover in the last quarter of 1983. Many other auxiliary services such as Facsimile, Paging, Telex and Viewdata are also available. In the near future Mobile Radio Telephones and Packet Switching will also be introduced.

Hong Kong Telephone which raises all its capital has some 20 000 shareholders. It operates the telephone service under Government franchise and is regulated by Ordinance. Since July 1983 the supply, installation and maintenance of competitive products has been deregulated. As a result a wholly owned subsidiary, Communication Services Ltd, was established to exploit the commercial prospects now open to the group.

FORECASTING ACTIVITIES IN HONG KONG TELEPHONE

There are three forecasting departments, Section Forecasting (SFD), Demand Forecasting (DFD) and Analytical Support Department (ASD) within the Marketing Branch.

SECTION FORECASTS

Section forecasts (outside plant forecasts) are prepared by a thorough survey of each exchange area every second year to establish a register of business and residential tenancies to capture ongoing changes. Updating of these forecasts takes place whenever new information is available. The objective of the section forecast is to estimate the total number of cable pairs required in an exchange for a period of seven consecutive years and three base years 1991-1996-2001. Such a procedure is very appropriate and necessary. The main user of the section forecasts is the External Operations Planning Department to plan and engineer the line plant network.

DISTRIBUTED DEMAND FORECAST

The distributed demand forecast (planning forecast) is an annual forecast of demand for seven consecutive years and three base years per exchange. It is prepared judgementally. Information used in preparing the forecast includes : Government Ten Years Housing Program issued and revised quarterly, building schemes which incorporate the private sector and new town development programs which include commercial and industrial developments. Little modelling or even simple curve fitting is applicable in these projections due to high volatility and exchange boundary changes. These are bottom up forecasts and when summarized, are reconciled with the macro forecasts which will be discussed later. The major user is the engineering development branch, responsible for planning of switching equipment in each exchange. Good accuracy of distributed demand forecast is essential due to the large capital outlay for purchasing equipment on the one hand and the possibility of shortage of equipment, and consequent loss of business, on the other.

ANALYTICAL SUPPORT

Analytical Support Department (ASD) was established in 1979. The preparation of macro forecasts is its main responsibility. The macro forecast of annual Net Gain Lines on a Company basis for seven years, Long Range forecast for 2001 (twenty year forecast), forecast of International Direct Dialling (IDD) calls, and number of international manual calls are produced for budgetary purposes. Forecasts are reviewed quarterly and revised on special request. Company revenues obtained from IDD calls and revenues from local telephone service are not forecasted.

Any forecasting research and forecasts for series not being forecasted before are also the department's responsibilities. All the forecasts are prepared by statistical modelling. Forecasts are monitored and models are updated whenever necessary. The development of the above forecasts will next be discussed.

NET GAIN LINE (DEMAND) FORECAST

Demand can be defined as a call for a commodity on the part of the consumer, combined with the power to purchase. Thus simple economic theory concludes that demand is a function of price and income, which if possible should be included as independent variables in the econometric models. The price of the commodity is the telephone tariff, income can be expressed as Gross Domestic Product (GDP). The forecast data should reflect the anticipated customer demand for service in a given period. Such demand is represented by the net gain in lines in a given period. Net gain is defined as lines installed less lines ceased.

We do not prepare our own GDP growth forecasts. References are mainly made to those issued by the Hong Kong Government and the Economic Research Centre of the Chinese University of Hong Kong. The former usually covers one year only and the latter a few years ahead. With our own interpretation the GDP growth forecasts are input for forecasting telephone demand. When the GDP growth forecasts are input an upper/lower limit is also set with which a range forecast is produced. Given accurate GDP growth forecasts the model will perform satisfactorily. However, due to Hong Kong's political/socio-economical features it is very difficult to obtain accurate long-term GDP growth forecasts. Under these circumstances the model is considered good for short-term use, that is, not more than three years ahead. However, forecasts prepared by the model beyond that time span are used for consideration in reaching the recommended range forecasts.

Hong Kong's real-term GDP annual growth rate averaged 10% over the period 1973-1982 with a wide range of 1.8% in 1974 to 18.8% in 1976. Hong Kong, being a small economy is export oriented and is heavily influenced by its main trading partners, namely the United States, the United Kingdom, West Germany, the People's Republic of China and Japan. Generally, Hong Kong's economic trend follows the direction of the global one. However, its economic cycle is comparatively short and it is quick to react to change.

The initial approach to prepare an annual forecast of net gain lines is based on a simple econometric model. Net gain line is expressed as a function of Net Gain Line_{t-1} (lagged one period), change in deflated tariff in year_t, growth of GDP in 1973 prices and three dummy variables to correct for the outl[illegible] Historical actual data from 1962 to 1982 were us[illegible] The model structure is as follows :-

$$\begin{aligned} \text{NGL}_t = 11283.91 &+ \underset{(13.57)}{0.68}\text{NGL}_{t-1} - \underset{(-4.58)}{105.21}\text{TRF}_t \\ &+ \underset{(4.78)}{3.61}\,\Delta\,\text{GDP}_t + \underset{(3.74)}{21125.07}\text{D68} \\ &+ \underset{(4.54)}{26723.71}\text{D71} - \underset{(-3.56)}{22425.78}\text{D74} \end{aligned}$$

Figures in parentheses are t-statistics
$\bar{R}^2 = 0.96$
F-statistic = 77
Standard error of estimate = 5676
Durbin-Watson Statistic = 2.17

As mentioned before, the GDP value supplied by the Hong Kong Government is subjectively increased and decreased in order to prepare a range forecast. In such a way low, medium and high range forecasts are produced.

Although this model has produced good results in the past it becomes increasingly difficult to rely on the predicted value of GDP due to Hong Kong's present political environment.

For this reason some research was done to provide an alternative way to forecast Total Net Gain Lines. Two separate models were built, one for residential the other for business net gain lines, based on total domestic flats completed for residential market and non-residential usable floor area for business market respectively.

The following models were constructed using annual data from 1968 to 1982.

$$RNGL = 37816 + \underset{(8.09)}{0.54TDF} - \underset{(-7.42)}{103.53\triangle RTAR} + \underset{(5.68)}{12582D(71\text{-}73)}$$

where

RNGL = Yearly residential net gain lines
TDF = Total domestic flats completed in the year
$\triangle$ RTAR = Change of deflated residential tariff
D(71-73) - Dummy for the expansion period, 1971-73
Figures in parentheses are t-statistics
$\bar{R}^2 = 0.94$
F-statistic = 73.55
Standard error of estimate = 3392
Durbin-Watson Statistic = 2.28

$$BNGL_t = -2744 + \underset{(3.60)}{0.44BNGL_{t-1}} + \underset{(1.89)}{3.59NRUFA_t} + \underset{(9.66)}{2.09\triangle GDP_t} + \underset{(2.37)}{4513D71}$$

where

$BNGL_t$ = Business net gain lines in year 't'
$BNGL_{t-1}$ = Business net gain lines in year 't-1'
$NRUFA_t$ = Non-residential usable floor area (in thousand m^2) built in year 't'
$\triangle GDP_t$ = Growth of gross domestic product in \$M at 1973 prices in year 't'
D71 = Dummy for the year 1971
Figures in parentheses are t-statistics
$\bar{R}^2 = 0.96$
F-statistic = 89.31
Standard error of estimate = 1626
Durbin-Watson Statistic = 1.7

The relevant statistics and forecasts were obtained from Hong Kong Government (Census and Statistics Dept and Rating and Valuation Dept). Private sector forecasts were available only for 1983 and 1984, therefore only two year forecasts were prepared. Examining the past accuracy of Government forecasts, it was found that their forecasts were very optimistic. In order to correct this, forecasts of Net Gain Lines were reduced judgementally by two standard errors (Lower 95% confidence interval).

Comparing the forecasts of 1983 and 1984 prepared by this model to the forecasts of the GDP model, both are very close. It was found that whilst the change of tariff is statistically significant in the residential Net Gain Line model, it is not the case in the business model. One may conclude that telephone service is a must for business. The real growth of GDP is very statistically significant, that is, it is indispensable in the business model.

LONG RANGE FORECAST - NET GAIN LINES

A long range forecast required for strategic planning up to 2001 is prepared by curve fitting. Penetration factor, Total Lines/Total Population is developed for 1959-1982. Gompertz curve is fitted to the historical data. The long range forecast is obtained by multiplying the projected penetration factor by the population projection which is published by the Government Census & Statistics Department.

RECONCILIATION PROCESS

Before final forecasts of Net Gain Lines are approved and published reconciliation of the bottom up (planning) forecast prepared by the Demand Forecasting Department and the top down forecast prepared by the Analytical Support Department takes place. The demand forecast is arrived at by collecting information based mainly on Government and private housing data. Changes such as deferment or advancement of large Government estates are incorporated in this forecast. On the other hand the top down forecast prepared by the econometric model is only based on Hong Kong's economic indicators. Therefore, it is necessary to have a very close look at both forecasts and incorporate judgement before arriving at the final figures. From the Management point of view at the end of this process both forecasts should reconcile.

FORECAST OF INTERNATIONAL OUTGOING CALLS

There are three categories of International outgoing calls : International Direct Dialling (IDD) calls, operator handled calls to the People's Republic of China and operator handled calls (excluding PRC). With the introduction of IDD to Fujian Province of the People's Republic of China in September 1983 a new category has to be forecast in the near future, namely IDD calls to the People's Republic of China.

IDD CALLS FORECAST

The IDD calls forecast is prepared using a quarterly econometric model. IDD calls are expressed as a function of estimated real term Gross Domestic Product (GDP), IDD calls lagged one quarter, Average Revenue Per Minute (ARPM) deflated by Consumer Price Index (CPI) and a dummy variable to correct lagged effect of introduction of IDD to new destinations.

The model properties are as follows :-

$$\text{IDD Calls}_t = 9819.4197 + \underset{(155.6)}{0.9797}\,\text{IDD Calls}_{t-1}$$

$$- \underset{(-2.8)}{16521.765}\,\text{ARPM}_t + \underset{(3.7)}{15.0116}\,\text{GDP}_t$$

$$+ \underset{(2.2)}{19772.652}\,\text{D}$$

The t-statistics are shown in brackets
Durbin-Watson Statistic = 1.16
F-statistic = 72190
$\bar{R}^2 = 0.99$

PEOPLE'S REPUBLIC OF CHINA OPERATOR HANDLED CALLS FORECAST

This historical monthly data Jan 78 - Jun 83 are treated by double exponential smoothing. Seasonal index is developed by the adjusted ratio of actual to moving average method. The projected trend is then multiplied by the seasonal index to develop the forecast.

OPERATOR HANDLED CALLS FORECAST (EXCLUDING PRC)

This forecast of manual calls is prepared by pure autoregressive model. The trend-seasonal model is expressed with the lags of one, three, twelve, thirteen and fifteen. The structure and related statistics are as follows :-

$$\text{NCMC}_t = 94462.737 + \underset{(1.7)}{0.1822}{}_{t-1} + \underset{(4.3)}{0.4664}{}_{t-3}$$

$$+ \underset{(9.8)}{0.6844}{}_{t-12} - \underset{(-2.9)}{0.3053}{}_{t-13} - \underset{(-4.5)}{0.4250}{}_{t-15}$$

Durbin-Watson Statistic = 1.90
F-statistic = 28.0
$\bar{R}^2 = 0.73$

No revenues are forecasted at present, they are obtained by the number of calls forecasted times ARPM. Forecasts for longer period are prepared by simple extrapolation of past and forecasted history.

CONCLUSION

In this paper a number of forecasting approaches of various degree of sophistication as applied in Hong Kong Telephone have been briefly discussed. As shown no single forecasting method will be effective for every set of data. Every series is likely to present particular problem as illustrated. Familiarity with the various techniques along with a good deal of experience and judgement is essential. Over the past years Hong Kong Telephone has kept abreast with the latest developments in the forecasting field. This allows for the selection of most suitable technique to be applied in particular forecasting problems and hopefully for the preparation of forecasts with minimum errors. However in the present restricted sense of forecasting, any forecasting model must be used with care and tempered by that illusive but indispensable element —— judgement. However, one must remember that forecasts are made for some purpose and as such the quality of a forecast is determined by the quality of the decision to which it leads.

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DOES COMPETITION IN TELECOMMUNICATIONS HAVE ANY NATURAL BOUNDARIES?

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The varied demands of users are the driving forces which define the shape of the telecommunications industry. Diverse and cost-effective communications systems, tailored to the specific needs of industry, are necessary to maintain a competitive edge in domestic and world markets. As national governments and international organizations reevaluate their telecommunications structures and policies, they are finding that the "sole provider" system is no longer adequate. Thus, we are experiencing a world-wide evolution toward multiple-supplier environments in which the Pacific region is certain to participate.

The American Council for Competitive Telecommunications (ACCT) is an association of recent entrants to the U.S. long distance communications industry. Our companies are known as "specialized carriers" or "Other Common Carriers" (OCCs). They include GTE Sprint, MCI, RCA Americom, SBS and USTS. These companies compete with the long-established carriers (AT&T and Western Union) in intercity transmission services. Our members offer a wide range of voice, record, video, data and facsimile services designed for corporate and government, as well as residential users. ACCT was organized in 1976 to oppose telephone monopoly legislation and to advance the cause of competition in intercity telecommunications in every available forum.

A. Telecommunications Competition is the Invention of Consumers

In 1976, AT&T told the U.S. Congress that competition in telecommunications was "contrived" by the Federal Communications Commission (FCC). But the truth is that telecommunications competition is the invention of consumers.

The diverse demands of telecommunications users in the world today are the driving forces which define the shape of telecommunications nationally and internationally. Governments throughout the world are experiencing the pressure of these demands and are being forced to reevaluate their telecommunications structure and policies. Users have become more sophisticated in their awareness of the opportunities available through the use of telecommunications and computer technologies. Many industries have recognized that more diverse, cost-effective communications systems, which can be tailored to their own specific needs, are necessary to maintain their competitive edge in domestic and world markets.

This recognition is most apparent in countries in which the wide-spread availability of a basic, domestic telephone system has been achieved. As governments reevaluate their telecommunications policies, one point becomes increasingly clear. The "sole provider" or monopoly system is not effective in meeting the more diverse and specialized needs of consumers today.

B. The U.S. Experience

The United States domestic communications experience has also been, until recently, one of government-sanctioned monopolies for local telephone service, telephone equipment, long distance, and parts of the international industry. Local telephone monopoly franchises are held by the American Telephone and Telegraph Company (AT&T) and some 1500 "independent" telephone companies. AT&T controls more than 80% of local telephone service, generally in the major cities, while the independents principally serve the smaller cities and rural areas. Until recently AT&T was the sole provider for the long distance voice market.

The telephone industry in the U.S. was initially a competitor to the telegraph system and, thus, it has always faced some competition. Since 1949, there has been some direct and beneficial competition in the common carrier mobile radio service and among international record carriers. New carriers were authorized by the FCC in the 1950's to transmit video signals to cable television operators in remote areas which AT&T chose not to serve. By 1970, there were 59 of these. After a large video rate increase by AT&T in 1969, a number of these companies began to compete directly with AT&T and new companies came into the business.

The modern U.S. competitive era began in 1959 with the private microwave decision, in which radio frequencies were authorized for private systems to satisfy needs which were not met by the telephone industry. A number of such private internal communications systems were built by the few organizations that had a sufficient volume of traffic between two points (and often their own right-of-way) to justify the construction of a separate system. These included gas and oil pipeline, railroad and similar companies.

In its 1968 *Carterfone* decision, the FCC permitted the attachment of customer-owned terminal devices to the telephone companies' lines, provided such devices were not harmful to the network. The Commission's decision was prompted by the desire to give individual customers the opportunity to choose the kind of terminal equipment they needed. As a result, innovative products have been introduced by interconnect companies while the established telephone companies have been stimulated to produce their own innovations and better devices. The success of the decision can be seen in a veritable explosion of new terminal features and devices.

Carterfone was followed in 1969 by the *Microwave Communications, Inc.* decision in which the FCC finally approved, after a six year controversy, the first application to build and operate "specialized" common carrier microwave facilities. In its *Domestic Satellite* decision in 1970, the FCC authorized any financially and technically qualified entity to establish "specialized" satellite services. In the 1971 *Specialized Common Carrier* decision, the FCC determined that new entry of companies to compete in the interstate business and data transmission market would have significant public benefits. In 1976, the FCC made its *Resale and Shared Use* decision. After the 1978 *Execunet* decision was overturned by the Circuit Court the specialized carriers were authorized to provide switched-voice long distance services in direct competition with AT&T's Message Telecommunication Service.

In 1979, the FCC opened the domestic record market to competition, formally ending the Western Union monopoly. The FCC's 1980 decision in the *Second Computer Inquiry* removed the distinction between traditional common carrier telecommunications (subject to FCC regulation) and computer services (not subject to regulation).

AT&T and its friends in the independent telephone industry fought most of these decisions in the FCC and in the courts -- and lost in every case. Then the telephone companies mounted an all-out campaign for legislation in the U.S. Congress. The established industry fought the emerging competition with warnings about wasteful duplication of facilities and "creamskimming" the high volume routes. It claimed that competition threatened national rate averaging and universal service. It was also said that the interconnection of these competitors would cause technical harm to the nationwide public network and that this would threaten the integrity of the single nationwide network.

Fortunately, Congress held a number of hearings where these claims were revealed to be without foundation. And the users of the new competitive services were able to describe their telecommunications needs and show how the established industry had not been meeting them. As a result, a Congressional consensus favoring the FCC's pro-competition policies emerged. Had the original industry-sponsored legislation been enacted, it would have effectively overturned a series of FCC and court decisions and established, for the first time, a virtual *de jure* monopoly in long distance telecommunications and supply of terminal equipment in the U.S. It would also have been a major setback for U.S. technology and would have impeded our capacity to compete both at home and abroad.

In the meantime, AT&T had begun to respond to the emergence of competition in ways which were seen by the competitors and, eventually, by the Department of Justice, to be anticompetitive and unlawful. Accordingly, the U.S. Department of Justice filed an antitrust suit against AT&T in 1974. Among the Government's claims were that AT&T impeded its competitors' interconnection to its local exchange facilities, failed to provide them interconnection on equal terms, and priced its intercity services without regard to cost. The Justice Department also asserted that AT&T refused or impeded the connection of competitors' terminal equipment and exploited the structural incentives for its local operating companies to purchase Bell equipment without considering the quality and price of non-Bell equipment.

After about a six-month presentation of the Government's case, Judge Greene concluded:

> "The testimony and the documentary evidence adduced by the Government demonstrates that the Bell system has violated the anti-trust laws in a number of ways over a lengthy period of time."

Since most of the evidence in the case was not in dispute, AT&T's defense turned on issues of intent and on whether the company was excused from liability for antitrust violations because its actions had been approved by regulatory agencies. However, the latter argument had already been rejected both by Judge Greene and his predecessor in the case.

With the handwriting on the wall, therefore, AT&T chose to negotiate a settlement with the Government rather than wait until Judge Greene wrote a restructuring order over which it would have no influence. Hence, the announcement of a settlement was made on January 8, 1982. However, after further proceedings, the Judge insisted on a number of changes in the agreement as a condition to his entering a judgment.

Under the terms of the Modification of Final Judgment (MFJ), as it was revised, AT&T is to spin off 22 Bell Operating Companies (BOCs) and is to keep Western Electric, Bell Labs and Long Lines. The BOCs, on the other hand, will be limited to local exchange service and exchange access, Yellow Page advertising and the marketing (but not manufacturing) of customer premise equipment.

As a result of the settlement, we are witnessing the most dramatic restructuring of any industry in the history of the U.S. Splitting up AT&T removes the toughest barrier to the development of new technologies in the U.S. telecommunications industry.

The benefits of the initial FCC decisions which experimented with limited competition have been overwhelming. The competitive environment which emerged following Carterfone has sparked innovation, reduced costs for terminals, and has stimulated consumer responsiveness on the part of the established telephone industry . And the telephone companies, themselves, have benefited because competition has fostered new uses of the telephone network and has, thus, produced new sources of income.

The first switched digital communications network, packet switching, and more advanced high speed data and facsimile capabilities have been made available by competitors. Satellite technology has made a number of new and diverse services available to remote regions in the U.S. where conventional terrestrial systems will not work.

The impact of the historic industry restructuring involving AT&T will also be dramatic. This is so because the separation of monopoly local service from competitive services is consistent with the technology, economics and operations of the industry in the U.S. It will accelerate the shift in our national economy from an industrial to an informational base. Intercity competition should flourish because transmission competitors will soon be able to compete with AT&T on fairer terms. That is because the MFJ requires the divested local telephone companies eventually to provide equal access at cost-justified rates.

Competition is also on the horizon for the local telephone companies. Cable television companies are moving into the home information industry and the newer systems include many which have two-way, interactive capabilities. MCI is already developing arrangements with cable companies to provide alternative and superior local transmission for high volume users. And cellular systems are rapidly being deployed, with one in each market to be offered by a non-telephone company.

The FCC has taken steps to revamp the financial arrangements between the long distance and local communications companies. Under its access charge order in Docket 78-72, it proposes to substitute cost-based access charges for existing revenue transfer mechanisms and to require end-users to pay, eventually, the entire cost of the subscriber loop. In a related docket, 80-286, it is creating a Universal Service Fund to which long distance carrier surcharges will be paid to help keep down the rates for local service in high cost exchanges.

The U.S. Congress is actively considering legislation (H.R. 4102 and S. 1660) to revise the FCC's plans, in particular to delay, or prohibit, the imposition of end-user access charges for residential and single-line business subscribers. The House bill would also require the FCC to continue the existing differential in the rates paid by AT&T and the OCCs for access to the local exchange companies, but only until equal access is provided in any given area. Both bills would also provide for subsidies to low income persons who subscribe to "lifeline" telephone service.

C. Canada, the U.K. and Europe

Canada and European countries are experiencing similar pressures for reorganizing their telephone industries. Developments in some of these countries go a few steps beyond recent parallel developments in the U.S.

1. The Canadian experience

The Canadian multi-supplier telecommunications industry consists of a blend of private, governmental and joint private-governmental corporations and organizations. Carriers are regulated either by the federal agency, the Canadian Radio-television and Telecommunications Commission (CRTC), a provincial government utility board, a provincial government cabinet, or a municipal council.

There are two national telecommunications systems in Canada: the TransCanada Telephone System (TCTS) and the CNCP Telecommunications (CNCP). TCTS is an unincorporated association of the largest telephone company operating in each province and Telesat Canada, the domestic satellite carrier. It provides most of the domestic local and long distance public voice telephone service, TWX, data and audio and video services.

CNCP, was formerly a national telegraph carrier which grew with the transcontinental railroad. It has expanded its service offerings, due in large part to CRTC decisions granting wider system interconnection. Its services include private line voice, telegram, telex, data and audio and video transmissions. CNCP operates its own national microwave system and its own switching centers, but in general leases local loops from local telephone companies, and receives connections similar to those presently offered to U.S. intercity competitors by AT&T and the independents. Requests for direct class-4 office connections have been denied by the CRTC.

Customer options for terminal equipment have also been opened up. The CRTC has ordered the private companies to allow connection of customer provided equipment to their provincial networks.

2. The United Kingdom experience

The United Kingdom's telecommunications organizational structure has been undergoing significant change over the last three years. All telecommunications services were provided by the British Post Office monopoly until 1980, when these functions were split off and vested in a separate government-owned public corporation, British

Telecom (BT). The BT provides telecommunication and data processing services throughout the UK. It is responsible for the operation of these services, but acts under the control and supervision of the Secretary of State.

BT, as a nationalized industry, has no direct access to financial markets. Its borrowings are strictly controlled by the Government. As about 90 percent of its investment program has been subscriber financed, BT charges must cover current operational costs as well as the investment program. As a result, charges have risen sharply and the Government believes that a change in capital structure and ownership of BT will result in greater efficiency. So the Government has introduced legislation which, while keeping BT as a single enterprise, will enable it to be converted into a public company and allow for the sale of shares to the public.

The British experience with competition is quite limited. There is only one other licensed intercity carrier, Mercury Communications, which almost aborted when BT refused to interconnect it (a problem which U.S. intercity competitors faced with AT&T). BT has since been forced to interconnect. Mercury's service is initially intended for organizations with substantial information needs. The BT's response to this modest competition includes a substantial reduction of long distance telephone rates. BT has also speeded up the introduction of its high-speed digital service.

3. The Federal Republic of Germany

In the Federal Republic of Germany, telecommunications is directly controlled by the state through the Deutsche Bundespost, which is headed by the Federal Minister of Posts and Telecommunications. The Bundespost designs, builds and operates the public telecommunications network. All equipment is produced by the private sector although its connection to the network requires DBP approval. Connecting and non-connecting private networks are permitted but require DBP approval.

Until the recent switch in control of the government, no significant changes in the organization of telecommunications had been expected. However, the new Minister of Communications stated last October that the Germans had been stimulated by U.S. deregulation and British liberalization efforts and were studying the possibilities of adapting the advantageous aspects of such policies. Legislation is a possibility in the future. The biggest change in national communications policy since the new administration took over has been the decision to move ahead with the rapid installation of cable TV systems, a proposal which had been blocked by the previous administration's support of the Bundespost monopoly. The majority of cable networks will be privately owned, although the Bundespost will have some interest in these systems.

D. International Competition -- Atlantic Side

In international telecommunications, the demand for the benefits of diversity and choice, which a multiple-supplier environment can provide, has already been voiced and acted upon on the Atlantic side. Most major European governments, including France, Germany, and the United Kingdom, as well as the European Economic Community Commission (EC Commission), have concluded that industries which depend on telecommunications and computers will be the focus of economic growth in the next decade. The importance of knowledge-intensive industries is reflected in studies of the EC Commission for the "harmonization" of telecommunications, the French Nora-Minc and Madec reports, the recent establishment of the British Ministry of Information Technologies and numerous West German reports. They all generally agree that old methods of maintaining communications facilities and services must be changed to accommodate new economic developments.

Action to meet new business demands has already been taken. Several regional satellite proposals have been proposed, offering the monopoly INTELSAT some competition. EUTELSAT's first satellite has been launched. It will offer European countries another supplier geared more specifically to their individual needs. The British UNISAT proposal will provide an alternative transatlantic system and ARABSAT will cater to the needs of the Arab states. These systems either have been or are seeking coordination with INTELSAT.

Of further interest is the Luxembourg disclosure, last August, of its intention to launch fixed satellites for regional European telecommunications services. The proposed service will encompass such offerings as data transmission, video distribution and video conferencing in direct competition to EUTELSAT, which is controlled by European PTTs. EUTELSAT's reaction was one of shock. Preliminary indications are that it will attempt to block the Luxembourg project on grounds of potential economic harm (another objection which was voiced in opposition to competition in the U.S.). On a practical level EUTELSAT is already moving to respond by expediting the launch of its third satellite.

Two additional proposals for international transatlantic satellite service were announced last year in the U.S.: Orion Satellite Corporation and International Satellite Inc. Founded in 1982, the basic objective of Orion is to create private, user-owned international telecommunications satellite facilities. In March of 1983, Orion applied to the FCC in the U.S. for authority to build, launch and operate three satellites for communications between North America and Europe. The system will offer no services, but will simply sell its transponders. Purchasers will be able to custom-tailor both space segments and earth station to suit their own needs. Orion will appeal to major video programmers, natural resource companies with high volume data processing needs, such as broadband imaging systems operating continuously from remote sites. Customers will have to get their own FCC authorizations and operating agreements with the PTTs.

Orion is owned by a U.S. based investor group, but it has substantial financial support from Europe as well. The construction and launch of the Orion facilities will include manufacturers and vendors on both sides of the Atlantic.

In July of 1983, International Satellite Inc. (ISI) announced its proposal to launch a regional satellite system serving the North Atlantic basin. It plans to build three satellites and will sell or lease on a long-term basis one half of the system's capacity to high volume users such as multinational corporations, banks and broadcasters and will offer the rest to the general public on a tariffed common-carrier basis. As a result, ISI is planning on coordinating its system with INTELSAT. Since 85% of INTELSAT's revenues come from international voice (MTS) service, ISI does not see itself as a direct competitor, as it will concentrate on providing high-speed data transmission and video services.

INTELSAT's vehement response to competition was aimed primarily at Orion. It voiced its concerns in numerous fora, including the U.S. Congress. In its annual Assembly of Parties, held in October 1983, it finally achieved unanimous passage of a resolution which endorsed INTELSAT as the "single global satellite system." Although western nations were more openly pro-Orion, it was not surprising that developing countries were adamantly against the project. U.S. support for the resolution was facilitated because it avoided any direct mention of Orion or of any private satellite system.

The arguments expressed by INTELSAT and its supporters with regard to the Orion project were very interesting to U.S. observers. They were highly reminiscent of those used by the monopoly carriers, AT&T and the other telephone companies, only a few years before during the competitive struggle on the U.S. domestic scene.

Some of the concerns voiced by INTELSAT representatives were that competition in the form of Orion would threaten the integrity of the single global satellite telecommunications network; Orion would be "creamskimming" the high volume routes, but take none of the responsibility for subsidizing low volume routes; and that the Orion system would be a wasteful duplication of facilities while taking up scarce orbital slots. It was further stated that INTELSAT would be forced to raise its rates which ultimately would cause irrevocable harm to the international system and that developing countries would suffer the most.

Orion, on the other hand, argued that it should be considered a complement to INTELSAT as it offers only "specialized" services for private users rather than the public services provided INTELSAT. Orion also reminded everyone that there was a great demand by users for just such "specialized" services and that its system would not have even been proposed had not a need for such services existed or, conversely, if those needs had been satisfied by the existing international satellite establishment.

On a more practical level, INTELSAT has responded to the Orion proposal with its announcement last September of its new INTELSAT Business Service (IBS). The proposal is similar to Orion's proposed offerings. Although INTELSAT claims that the IBS was developed over 18 months ago, it appears that competitive pressure has, at the least, accelerated its availability.

IBS offers tariffed business services internationally linked to smaller earth stations which can be located on the customer's premises and also offers sharing possibilities. Services include video, teleconferencing, high and low speed facsimile and data, packet switching, voice, electronic mail and telex. IBS is a wholly digital service.

E. What's in store for the Pacific?

Countries of the Pacific region have been subject to similar domestic and international demands for change to those experienced across the Atlantic. Aside from the U.S. and Canada, Japan is the major Pacific nation to have re-evaluated its domestic telecommunications structure and policies.

In 1980, the Second Ad Hoc Committee on Administrative Reform began the examination of all Japanese government monopolies. The Committee presented its final recommendations to the Prime Minister in August 1981. It recommended that the government-owned public corporation, Nippon Telegraph and Telephone (NTT), which provides all domestic services, be sold to the private sector. It was also advocated that NTT's network be divided into competitive and monopoly sectors; the competitive services would be divested, and offered by a private company. The monopoly services would be provided by a regulated entity. It was further recommended that the regulated entity be divided into local and long distance service companies; that new companies be allowed to build long distance facilities to compete with the NTT; that the provision of customer equipment be completely deregulated and that NTT's equipment leasing and sales arm should be divested.

Some of the problems of the present system as cited by the Committee are similar to the weaknesses experienced by the large AT&T monopoly in the U.S. The list included a lack of incentive among management and employees to improve efficiency. Also, the strict control that the government has over NTT's budget hinders the NTT (according to the Committee) from executing business-like operations, and hampers the flexibility needed to deal with the many rapidly growing needs of the communications industry.

These recommendations appear to be highly controversial in Japan and it is not clear how many will be adopted. Legislation is expected to be introduced and, in spite of strong opposition from some members of the Diet, the Ministry of Post and Telecommunication and the labor unions, it appears that some of the recommendations will be adopted.

The final question is whether the development of international competition in the Pacific Region will parallel that on the Atlantic side. Despite the vast differences in geographical and political profiles of these two regions, certain developments clearly compare with situations in the Atlantic. Indonesia, Malaysia, Singapore, the Philippines and Thailand pioneered the first Pacific regional satellite system, PALAPA.

Japan recently proposed a regional satellite system which will encompass the provision of both basic services (telephony and TV broadcasting) for developing nations and advanced services for developed countries. The system would cover not only the Pacific islands, but would also reach the larger cities around the mainland perimeter of the Pacific Region. The Japanese proposal suggests the launch of a satellite in 1987 which will have a seven-year service life.

From the U.S. point of view, activities in the Pacific Region continue to increase in commercial importance, even though U.S.-Pacific international traffic routes are not as dense as U.S.-Atlantic routes. (Pacific traffic accounts for about 10% of U.S. international traffic as compared to 70% for Atlantic routes. During the FCC's Pacific Facilities Planning Process, it was noted that the emergence of Japan as a major economic power, the growing relationship between the U.S. and the People's Republic of China, the long-standing relationship with Commonwealth countries and the growth of Pacific trade, in general, were major factors in planning future U.S. international policy.

F. Conclusion

By now I trust an answer to the question posed in the title of these remarks is obvious. Competition does not have any natural boundaries. As economic recovery spreads around the world, and as other Pacific nations emulate the technological advances in Japan, the pressure for innovative equipment and services from business and private telecommunications users will be irresistible. And we have already found that monopoly supply is not fully responsive to customers' needs or well-suited to rapid development and offering of new kinds of products. Thus, regardless of the prevailing philosophy of any given national government or international group, I predict that both domestic and international communications in the Pacific regions will be opening up to increasing opportunities for competitive supply, to the substantial benefit of business, government and private users.

Demand and Need:
Problems of Planning Telecommunications Services for Rural and Sparsely Populated Areas

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1. Abstract

Progress has been slow in meeting rural communications needs. This paper discusses the underlying problem of using demand to indicate need in rural areas, suggests other criteria which could be used, and points out policy pitfalls which may undermine rural services where they now exist. It suggests strategies for reversing current trends in countries without sufficient investment in rural telecommunications infrastructure, countries which have invested in satellite technology but have been reluctant to apply it to rural needs, and countries which now have rural services which may be jeopardized by changes in regulatory policy.

2. The Problem

My initial reaction to the theme chosen for PTC 84 was discouragement -- even frustration. Why are we still discussing needs? Why has there not been more progress toward meeting those needs? Upon reflection, it seemed to me that the key to the problem lay in the topic for this session: "Economic Demand for Telecommunications as a Reflection of Needs." This paper addresses the problem of telecommunications planning for rural and remote areas: where demand may least serve as an indicator of need. Much of the Pacific falls into this category of rural and sparsely populated areas. Therein lies the problem.

A dramatic example of the extent of the problem was the headline on a recent press release from Australia's Department of Communications: "Minister Expresses Concern over 'Unrealistic Expectations' on Satellite." (Duffy, 1983) The Minister for Communications stated that he was concerned that "because of some degree of 'overselling' of the domestic satellite in recent years, many people living in remote areas have unrealistic expectations about the provision of non-broadcasting services via the satellite." The services in question were thin route interactive services: basic telephone service and audio conferencing networks for the Royal Flying Doctor Service and the School of the Air. The minister stated that the "unrealistic expectations" were mainly based on the belief that such services would be extended or improved at minimal cost virtually as soon as the domestic system was launched.

Is there a need for these services? Clearly yes. The Minister states: "There is no doubt that a reliable telephone service is required desperately by many people living in isolation." But is there sufficient demand? Apparently not.

While the plans for the Australian satellite are not yet finalized, the above example demonstrates that even when funds have been allocated to provide telecommunications facilities that could be used by rural and isolated residents, this may not happen.

2. Demand and Need in the Pacific

Much of the attention of PTC conferences in recent years has focussed on the needs of Pacific islanders for basic telecommunications services. Several studies have been carried out (e.g. RITE, 1983; PSSC, 1982). Pilot projects have been undertaken (e.g. the Peacesat network, the USP network). But still there is no reliable telephone service for the majority of the settlements in the Pacific outside the national capitals. And in the countries of the Pacific basin and Pacific rim, rural telephone densities remain very low (see Table 1). In most cases, these countries have not yet been willing or able to invest in telecommunications facilities to extend services outside the major cities and interurban corridors. In others, their investment in satellite technology makes it possible to reach virtually every citizen, but the potential seems far from realized. Indonesia has owned a domestic satellite since 1976; progress toward providing rural services has been very slow, despite an indigenous earth station industry and provision of services to isolated oil rigs and other strategic locations. The above example indicates that Australia may be slow to use its satellite system to achieve the goals of service to rural and remote areas that were expressed when the system was being planned. To date, India has indicated that its INSAT system will be used to provide TV reception in rural areas, but has not planned to use the system extensively for rural telephony, where it could be integrated with existing and planned terrestrial networks.

Thus even investment in satellite technology that could be used in rural areas does not guarantee that it will be applied for this purpose. But there is a third category of country where the technology exists and has been used to serve rural residents. The U.S. and Canada fall into this category, as, of course, do many other industralized countries that are not on the Pacific rim. Yet even in the industrialized world, the provision of services to rural and isolated residents may be threatened, as telephone companies, using the rationale of increased competition and deregulation, respond by raising the rates for rural services and relaxing standards for quality of service. Again, the problem is the discrepancy between demand and need.

3. Estimating Rural Demand

It is commonly assumed that demand for rural services can be estimated using standard traffic forecasting techniques. Yet, these estimates tend to underestimate actual demand for rural services, as demonstrated by the volume of calling once services are installed. For example, in northern Canada and Alaska, rural and isolated residents pay three to four times as much annually as their urban counterparts for long distance telephone calls, despite the fact that these people have significantly lower incomes than urban citizens, and many of them function in a subsistence-based economy (Hudson, 1983). But they recognize the value of being able to communicate with relatives and friends, and to order supplies, contact government agencies, compare prices for their fish and furs, arrange transportation, check on weather for flying, etc.

Table 2 shows the growth of telephone traffic in isolated Alaskan villages since the introduction of local exchanges to provide links to the telephone service via satellite. It should be noted that the largest volume of traffic is with the regional administrative and commercial center (Table 3).

4. Needs and Benefits

Despite the fact that demand in terms of actual telephone usage may exceed projections, it is obvious that rural and sparsely settled areas will not generate the volume of traffic that would come from more populated areas. Yet the need for communications may be significantly greater, because rural residents have few alternatives to using telecommunications -- they must rely on mail delivery that is often slow and dependent on weather conditions, or spend a significant amount of time and/or money to travel to convey or locate the information in person.

But is that need significant enough to justify the expenditure on telecommunications services? Clearly, this is a complex question which involves an analysis of the cost of providing service, opportunities to share costs with other users, and realistic forecasts of traffic growth.

But telecommunications supply and demand should not be seen as forming a closed system where revenues must necessarily cover costs for each separate component of the system. The benefits derived from the system may greatly outweigh the costs. The problem is that many of these benefits are not effectively measured, nor are they assigned any weight in the determination of system economic viability.

In Africa recently, a representative of a regional telecommunications organization stated that everyone who needed a telephone in Africa had one. Yet telephone density in Africa is lower than in any other part of the world, and in many rural areas, telephones are virtually nonexistent. But he meant that telephones had been made available to government agencies and entrepreneurs in cities where they could be used productively -- and he could see no reason to put them in rural areas.

However, evidence from field studies has shown that the benefits of rural telecommunications are substantial, and may contribute to the growth of the national or regional economy, as well as to the achievement of social and economic development goals. For example, at the national level, Hardy (1980) has shown that investment in telecommunications makes a small but significant contribution to economic growth, and that this contribution increases as telephone density decreases. Thus, investment in the most poorly served areas may yield the greatest economic benefits in percentage terms. In addition, the benefits derived from rural telecommunications use may significantly outweigh the costs. For example, in India, Kaul (1981) found that the ratio of benefits to costs for users of rural public telephone service were from 5:1 to 30:1 based solely on savings in time and costs of travel, and that rural entrepreneurs were willing to pay significantly more for telephone service if necessary. In the South Pacific, use of the ATS-1 satellite for audio conferencing by the University of the South Pacific has resulted in cost savings of 10:1 compared to the cost of assembling one representative from each USP extension center in Suva (Hudson,1981). In Africa, the ratio of benefits to costs of telecommunications use for various industrial and commercial enterprises in Kenya averaged 115:1 (Tyler, 1981).

However, these benefits do not show up on the balance sheet of the telephone company or telecommunications agency. Thus, there must be recognition at the national level that telecommunications is important to national development and the achievement of national goals and policies, if the necessary services are to be provided. In many countries in the Pacific region, this type of analysis is needed, so that telecommunications becomes recognized as essential infrastructure that must be provided along with transportation, water supplies, and electrification, in order to facilitate economic development and improve the quality of rural life.

5. Using Technology to Meet Rural Needs?

But what about the case where there is already a commitment to procure telecommunication technology that can be used for rural services? Why then is the technology not always applied to meet rural needs? The answers are likely to be complex, and may depend on political and institutional factors in each country. But the arguments are likely to fall into the following categories:

- o the costs of providing rural services are too high, and will not be able to cover the expected revenues;
- o other parts of the country can generate more revenue (e.g. interurban links);
- o other services can generate more revenue (e.g. TV distribution).

Concerning the first argument, we have seen that revenues may be greater than anticipated, based on rural requirements for service. Costs may also be lower, if the telecommunications provider takes the initiative to find or design appropriate equipment for rural services, and if the cost of service provision is pooled with other services -- both rural services including telephone, dedicated networks, and radio/television distribution -- and other non-rural services.

Concerning the second and third arguments, it is likely that higher traffic areas and other services are likely to generate more revenue. But is that justification for denying service to areas which have great unmet needs? Here, we must revert to the evidence of the indirect benefits, and examine the country's social, economic, and cultural goals. Goals of increased economic activity, universal access to quality education and social services, and increased participation by all citizens in development would all be served by greater investments in telecommunications. Yet short term profitability goals may result in strategies to emphasize only the most lucrative services, and may require each service to recover fully its own costs.

6. Policy Pitfalls

There are several principles endorsed by policy makers in various countries which can jeopardize existing services to rural areas, or can serve to justify continued lack of service to rural areas. These include:

6.1 The "practicability" approach: Telecommunications carriers may be required to provide services only where "practicable." If the definition of this term is left to the carrier, it may be free to conclude that service to a particular area or community is not "practicable" because of high capital costs, system design difficulties, or any other factors which might deter the carrier from servicing areas which it assumes will not be profitable. For example, the Australian Minister of Communications states: "Where practicable Telecom would also use the satellite to restore telephone links cut in disasters such as floods and to provide services at short notice or for limited periods." (Duffy, 1983; emphasis added). The definition and application of the "where practicable" term is apparently left to Telecom.

The draft licence for British Telecom also relies on a "where practicable" criterion concerning provision of public pay telephone services and rural services. The draft licence states that the Licensee shall provide or cause to be provided to every person who requires provision of voice telephony and other telecommunications services in a rural area:

> "...except where the provision of those services is not practicable, or where there is no reasonable demand for them, or to the extent that the Director (of the Office of Telecommunications) is satisfied that any reasonable demand is already met...." (Licence, 1983) (emphasis added)

These guidelines could be interpreted by a carrier to allow it to use virtually any criteria to determine whether the provision of a service is "impracticable." Of course, financial criteria are the most likely, and customers in potentially unprofitable areas may be the ones to suffer.

6.2 The "pay its own way" approach: Another argument used is that each unit should pay its own way. This unit may be designated as a service or a geographical area. The danger of this approach is that it ignores the well established mechanism of internal cross subsidy. It is well known that some traffic routes are more profitable than others. Yet, generally a tariff structure is established that charges the same price for the same service regardless of the location. For example, long distance rates are generally based on distance, so that a call between isolated points costs the same as a call between two cities the same distance apart. This is true even for competitive networks -- there is obviously internal cross-subsidization, with a tariff structure designed so that the system as a whole is profitable.

The carriers may use the "pay your own way" argument to refuse to provide or even remove rural services. In Canada and Alaska, government agencies and regulatory authorities had to require the carriers to extend services to remote areas which the carriers determined would not be profitable. In Australia the argument is being made that the average cost of a remote earth station and transmission facilities will be prohibitive, and that therefore thin route rural services may not be offered, or may be significantly delayed.

In Britain, according to the draft licence for British Telecom, each rural pay phone may be evaluated separately; those which do not generate sufficient revenue may be removed (Licence, 1983). This appears to be a particularly dangerous precedent for rural and pay telephone services in that country, and could be disastrous if adopted elsewhere.

6.3 The "residual pricing" approach: Telecommunications service providers in some countries have tions service providers in some countries have used residual pricing as a means of setting rates for local and other non-competitive or potentially non-profitable services. In the United States, it appears that residual pricing has been used to set rates for local service (Melody, 1983). Thus, local rates are based not on cost but on the amount which the carrier wants to recover once it has set prices for its potentially competitive or optional services (long distance, custom calling, etc.) The carrier may, however, argue that the residually priced service is actually subsidized by other services — e.g. the current notion that long distance subsidizes local service.

The assumption is that a carrier can arbitrarily segment its network for pricing purposes, and attempt to set rates that cover costs of each part of the system. Yet this approach, as we have seen above, fails to acknowledge the fact that the telecommunications network is indeed a system rather than a number of unrelated elements, and it also fails to recognize that the addition of each customer adds value to the whole network. Where residual pricing or arbitrary system segmentation principles are used, the losers are likely to be the rural residents who may be denied service or charge rates that make access to the network prohibitively costly for potential users.

7. Conclusions

The above discussion has highlighted the problems of relying solely on demand as a criterion for responding to need, particularly in rural and sparsely populated areas. Much of the territory in the Pacific islands and the countries of the Pacific rim falls into this category. Unless criteria are changed for providing services, and for maintaining service at appropriate tariff and quality levels, the rural populations of these countries are likely to remain unserved or underserved. Evidence which needs to be brought to the attention of planners and policy makers includes:

- the significance of indirect benefits of telecommunications services, particularly in rural areas;
- accurate forecasts of demand based on data from within the country or from other similar areas;
- the possibility of using cheaper technologies which are designed to meet rural requirements ratherthan modified from urban versions or expensively over-engineered;
- the economic integrity of the telecommunications network as a system in which the value of the network is enhanced by the addition of each subscriber, and the costs are allocated in such away as to make services universally accessible to users in both high density and low density areas;
- national, economic, social, and cultural goals that can be furthered through the extension or retention of telecommunication services.

While we appear to have made significant progress in the past five years through the development of new and cheaper technologies for rural services and through the commitments by several nations to invest in satellite systems that can serve rural areas, actual progress toward universal accessibility of telecommunications services remains painfully slow. In some countries, policy makers are not convinced of the importance of investment in this sector for other than urban commercial services. In others, the technology has been obtained, but it has not been used to serve the rural areas, often in the face of earlier justifications by the governments for their investment. In still other countries, changes in policy toward deregulation and the introduction of competition have created an environment in which existing rural services may both escalate in cost to users and deteriorate in quality.

The battle to reverse these trends is being fought in small skirmishes by rural residents, consumer advocates, and concerned officials around the Pacific. But it must be fought more vigorously and effectively. Otherwise, we may find ourselves five and even ten years from now still talking about rural communications needs.

Table 1:
Non Urban Telephone Densities in Selected Pacific Basin and Pacific Rim Countries

Country	Main Telephones /100 Population	%Telephones in Major Cities	%Population in Major Cities	Telephones/100 pop. in Non-Urban Areas
Chile	3.2	90.8	54.7	0.6
Colombia	4.9	92.5	46.0	0.7
Costa Rica	6.6	89.9	42.6	1.2
Ecuador	3.2*	95.3	42.1	0.3
Fiji	3.8	42.3	14.4	2.5
Korea, Republic of	7.4	65.1	47.0	5.9
Malaysia	2.9	56.4	18.2	1.6
Mexico	4.0	85.8	45.4	1.0
Palau (Belau)	6.8	57.7	49.2	5.7
Papua New Guinea	0.9	81.2	9.5	0.2
Taiwan	12.1	62.1	41.9	7.9
Thailand	0.7	79.9	15.3	0.2

Source: AT&T, The World's Telephones, 1982

* total telephones

Table 2:
Growth of Traffic in Selected Alaskan Villages Following Installation of Local Exchange Service

	First year (1979-1980)	First Four Years (1979-1982)
Alakanuk	179.6%	256.3%
Emmonak	54.1%	162.9%
Hooper Bay	323.6%	716.1%
St. Mary's	209.0%	360.2%

Table 3:
Distribution of Traffic from a Rural Alaskan Village (based on two sample months)

To:	% of Traffic
Major Cities	36.7%
Regional Center	38.3%
Other Rural Villages	20.0%
Interstate	5.0%
	100.0%

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Notes

Group 2 Resource Paper

Digital Systems Design for Control of Video Broadcasting

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1. Abstract

A broadcast system which uses radio broadcasting and microprocessors to produce combined video and audio productions is presented. This system would be used either as an independent medium supplying many of the benefits of radio and television while adding unique capabilities of its own, or as an adjunct or expansion of an existing broadcast radio or television system. Benefits such as low cost, potential for local production and feasibility for a developing nation are discussed. A model of subception is presented using a digital content signal which allows a receiver based microprocessor to screen out unwanted transmissions on the basis of their content.

2. INTRODUCTION

A new type of media is now possible. The advent of low cost microprocessors has made possible the incorporation of these microprocessors into the broadcasting and reception of audio and video data. When this is done, it makes possible the transfer of information in digital form. In addition, programming instructions, as opposed to merely audio and video data, can be transmitted. Such a Broadcast Digital Programmed Video system is similar in many ways to broadcast radio and television but it has basic differences and potentials which are not present in broadcast radio and television as these media are now used.

3. DESCRIPTION OF THE SYSTEM

3.1 BASIC ELEMENTS

Let us imagine a system which uses, as its broadcast hardware, standard audio broadcast equipment for radio. Information sent over this radio channel is received by a standard radio receiver followed by a modem which decodes the information in the broadcast signal. The information is then transferred to a microprocessor where it is used to control a television monitor. This basic description of the system shows that when the Programmed Video hardware is compared to many other kinds of media, the hardware is quite simple. The modem and microprocessor are added, but the information channel is simply a voice grade audio channel.

The microprocessor in this system gives it many potentials which are not present in standard television and radio. Perhaps the most obvious of these potentials is that the presentations are no longer necessarily taken in passively by the audience. This capability is a way of increasing radio's impact. It is possible to send productions which interact with and respond to the audience. Such active presentations are made possible by the fact that the information sent to the microprocessor need not be for a single presentation, but can be for a set of different possibilities where the possibility which is realized is dependent upon the reaction of the audience.

There are many other reasons why this new medium is different from alternative media. It can be a very low cost alternative to television. Low production cost makes possible local control of production. In addition, as an alternative to television, this medium has a great deal more in the way of educational potential. It has more variety in its ability to present information in diverse forms. Conventional television reception is one of many capabilities of this system.

The reason for calling this system Broadcast Digital Programmed Video is a combination of description and conventions used by other media. This system is a broadcast system in the same way that broadcast radio and television are broadcast systems. It is digital in that the form of the information sent is digital information instead of analog information as is the case in most present day radio and television.

The word programmed is used in the description of the system because it is controlled by a microprocessor. The system is not simply the reception of a flow of information from a broadcast source but rather the reception of a flow of instructions which a microprocessor uses. These instructions are carried out separately from the reception of the information. The actual carrying out of the instructions can be tailored to local conditions so that each of the sites which receive the production can present the information in a form specified by programming choices based on local conditions. Since the word program is commonly used in conjunction with both media and computers, confusion will be avoided by using "production" rather than "program" when referring to the standard media context.

This system is called video because one of the forms of information which is sent is visual or video information. However, the information is not limited to video. Television, which means distant vision, is likewise not limited to visual information. Instead of having a list of strung together words describing all the possible forms of information, the single word video is used to indicate that capability. Other capabilities such as audio are assumed.

3.2 COMPARISON WITH TELEVISION

The end result of Programmed Video can be the same sort of presentations produced by standard radio or television. However, it would be expected that there would be some differences in the sort of presentations which would be produced on these systems. Although the continuous action of television would be possible given an adequate amount of information flow in the Programmed Video situation, the value of Programmed Video probably lies more in ways of approaching the continuous action of television with much less information flow on narrow bandwidths. Thus, Programmed Video, in order to limit information flow, would tend to be more like cartooning than live television. When pictures of full definition are used, Programmed Video would appear as a slide show rather than as continuous television. In both of these cases much less information needs to be transferred. Once a particular picture is sent and received, it can be held as long as desired without any more information being sent. On the other hand, when television presents a fixed picture, the picture is continually resent because the television has no local memory with which to store it.

The content of productions sent by Programmed Video need not be different from those sent by television. The unique features which Programmed Video has that are not particularly possible in present day television include sending a family of presentations rather than a single presentation. A family of presentations refers to the fact that a number of different presentations can occur to the audience as the result of the sending of one production. The manner in which these different presentations are chosen can be through choice exercised by a member of the audience or through the use of random elements. Choice is determined by interaction with the particular audience. Random elements are basically random numbers generated by the microprocessor. A reason for using random elements is to make a situation which is not completely predictable so that a presentation may be repeated many times with new benefits each time. It will be different every time it is repeated. A simple example of this is a game. In a card game a random element is the shuffling of the cards. It is desirable to play the game repeatedly, but one example of the game is all that is needed. Every time the game is played, only the random elements are different. These random elements are commonly used in computer software for audience consumption as computer games. A presentation which is broadcast may be similar to a presentation such as used by a local microprocessor from a recording.

Perhaps the more important way of producing a family of presentations is to have interactive information from the audience. Choices would produce presentations which would be more appropriately tailored to the audience than a single presentation. Millions of people who form the audience for a single broadcast could each have a unique presentation. Attempts are already made on television to produce some sort of interactive presentations. For example, in the United States, there was a national driving test in which people were questioned about their various driving skills and then graded on them. A combination of measurement and information produced a test which had some aspects of uniqueness for each member of the audience. However, the actual presentation viewed was the same in all cases.

With Programmed Video there is no necessity for the presentation to be the same for each member of the audience. Once information has been received by the controlling microprocessor, the actual presentation may be changed to suit a particular member of the audience. A simple form of interaction which may be very important and which is possible with Programmed Video is personal scheduling. There is no reason why the speed of a presentation should not be suited to the individual. With a small amount of interactive information from the viewer, the speed at which a production is received can be changed to suit an individual.

3.3 CONTROL OF CONTENT BY SUBCEPTION

From a psychological viewpoint, a basic problem with media is that there is too much information available. In order to screen out unwanted information, it is generally necessary to receive the information in order to decide that it is unwanted. The alternative is to ignore all information including many possible segments of desired information. In psychology, subception refers to the situation in selective attention in which one signal is attended to while others are ignored. Since ignored signals must at least be identified to be ignored, some perception of the rejected signals must occur. This sub-perception is called subception. If a digital content signal is used in Programmed Video, a locally based microprocessor program can determine if the current content on the channel is desired for reception. For example, a 2 bit content signal could be sent each second with the following coding. 0 means no unusual content, 1 means explicit sexual content, 2 means violent content, 3 means socially inappropriate behavior such as drug taking. Given this system, movies would not need to be edited for television and the audience could make more selection on what they wanted to see. The addition of this signal would be less complicated than producing Closed Captioning. A subception capability would revolutionize television production and might answer many political problems concerning broadcasting across national boundaries.

3.4 ENTERTAINMENT VALUE

In comparing the usefulness of Programmed Video and television, the entertainment quality of the presentations will tend to be changed as the information flow is reduced. These differences may be compared to the entertainment quality of a play which is observed live versus the entertainment quality of a play which is televised. To the degree that a narrow information channel makes it so that the production is increasingly far away from live performances, the perceived reality of the production will be reduced. However, even with a small information flow, the interactive ability of presentations in Programmed Video will greatly enhance their attractiveness and usefulness in ways such as education. It is very clear that educational productions which are intended to be received in a passive manner are inferior in their ability to produce learning to educational productions which can be used in an interactive fashion.

There is not much precedence for judging how entertaining the interactive aspects of presentations are. In personal interaction between people, it is fairly difficult to think of the interactive element being removed. In some types of entertainment such as modern theatre and modern dance, there is a strong effort to produce interaction with the audience. These situations are very successful in their way. However, since they represent a rather avant-garde approach to entertainment and are usually presented live to small audiences, it is difficult to evaluate how successful they would be in mass communication.

A closely related form of interactive entertainment is the situation of computer games. These have been present on very large computer systems for many years, and directors of large computer facilities which serve large numbers of people in a timeshare fashion have found that they have had to limit the use of the system for interactive games because they were so popular. The Programmed Video situation would probably be an improvement on computer games because with continual programming there would be new challenges constantly presented rather than going over the same game. Also, locally produced games will be directed toward local audiences and will be more appropriate for those receiving the presentations than games produced for other audiences.

The Programmed Video system has an inherent ability to monitor its own usage. The operating system of the microprocessor could easily have built in ability to keep track of the usage of the system by keeping an internal record of such usage. By reviewing the usage record of various types of productions, the producer for Programmed Video would have surveys allowing the evaluation of the impact of productions. In this way, audience demand for certain types of productions can be monitored and schedules revised to reflect audience demand.

3.5 COMPATIBILITY WITH RADIO

Radio is available to the entire world in a diversity which far exceeds television. A Programmed Video system would most likely be used to expand the capabilities of a radio station while allowing normal audio reception for those people not able to receive the extra information. Local broadcasters would be able to enhance broadcasts with video. Educational programming of a different sort would be possible. International shortwave services would be able to supply an international video service without many of the problems that would tend to prevent such an endeavor by standard television.

3.6 COMPATIBILITY WITH TELEVISION

In consideration of a Programmed Video system it is important to relate it to television. This relationship can be described in several ways. There are two situations of interest. One is the installation of a Programmed Video system in an area where television is not yet available. The other is the installation of Programmed Video in an area where television already exists.

In the event that television does not exist in a region, the introduction of Programmed Video will reduce the cost of television hardware at a future time because some of the equipment will already be purchased. Thus Programmed Video may lead into television. However, in terms of customer demands, a Programmed Video system would probably satisfy most desires for television. This satisfaction may make television less worthy of investment since many of the values to be gained from television would be already realized.

If television already exists in a region, the additional hardware necessary for a Programmed Video system is a small increment due to the existing equipment. The introduction of Programmed Video would not seriously reduce the use of television since television viewing habits would be firmly estabilished in the audience.

The new capabilities of Programmed Video are valuable enough to make it worthwhile as an addition to television. Some of the features that Programmed Video would add to television are games with entertainment and educational value, monitoring of both television and Programmed Video usage to survey audience demands, informational services such as weather, schedules and annoucements, as well as education productions. Teletext and Viewdata systems provide some of these capabilities, but Programmed Video is more inclusive.

In some sense television and Programmed Video combined have an aspect of super television. The combination might be imagined by science fiction writers as the natural course of evolution of the present television systems. In many ways Programmed Video by itself, conveying information over a narrow bandwidth, is probably closer to the super television of the future than is present television. It is the interactive capability of Programmed Video which is more of a basic requirement of such super television than is the ability to convey live information. With a channel width equal to that of television, Programmed Video would equal or exceed television in all ways. The system which would exist with a wide channel information transfer in Programmed Video could be everything we expect super television to be. Productions could make use of all the capabilities of live television, audience interaction, multiple information transfers, and microprocessor control.

3.7 FUNCTIONAL AND TECHNICAL DESCRIPTION OF THE SYSTEM

The simplest manner in which to actualize a Programmed Video system demonstrates the basic simplicity of the system. Productions are made using a microprocessor, a television camera, and programs for the microprocessor (computer software) which direct the microprocessor in creating new presentations. A television camera is not necessary if the producer does not need to produce a television style picture. Once productions are created, they are sent over an information channel such as an audio channel on radio with a standard radio transmitter. This signal is received by a standard radio receiver and fed to a modem for translation and then into a microprocessor. The modem is a translator which changes audio data from the radio channel into digital data for the microprocessor. The microprocessor then controls the operation of a standard television style video set by means of both stored programs and received programs. Local inputs to the microprocessor allow the audience to add information for use by these controlling programs. Input would be accomplished through many means including pushbuttons, keyboard, and microphone.

There is no problem at all if it is desirable to have Programmed Video broadcast on wider channels than an audio channel. However, it should be clear that a great deal of Programmed Video production can be done on these narrow channels.

The form of information used in Digital Programmed Video differs from the analog form used in conventional radio and television. The difference between digital and analog may be described in terms of a number line. Digital information is a way of coding information so that each piece of information is one member of a set of all possible pieces of information. For instance, we could have one of the five numbers from one to five with five different possibilities. That information would be similar to digital information. Analog information, on the other hand, is continous information where all the possibilities can not be listed. A real number between one and five is a set of many different possibilities. There is no way of listing the whole set. It would appear in the description just given that analog information would be much more valuable than digital information, because there is no limit to the possibilities, as opposed to the case in digital information where the set of possibilities are precisely known. But actually, when the set of all possibilities is known, it becomes easier to distinguish between proper information which is being intentionally sent and accidental noise which is not intended. Digital methods therefore can be very powerful in doing what is obviously a first goal of a broadcast system: to send a large amount of information very accurately.

The microprocessor which is used for production and the microprocessor which is used for reception can be essentially the same sort of machine although different programming would be used for production than that used for reception. The digitally produced presentations do not suffer the same degradation as analog productions. In analog productions it is customary for production equipment to be of the best quality through each stage of use. Analog productions inevitably suffer some degredation at each stage of use and expensive equipment is used to minimize this effect. Digital productions are less sensitive to degredation. Under adequate conditions a digital presentation can be expected to pass through transmission with no degredation. Thus there is no improvement to be gained from fancier equipment.

Although presentations may be degraded by the transmission system, retransmissions will be independent, all potentially undegraded. The quality of color definition, sound and so on will be somewhat dependent upon the consumer's Programmed Video equipment which may range from a black and white screen to a high quality color video set or from a single speaker receiver to a stereo receiver. Storing digital productions does not in general introduce degradation. A digital presentation can remain of the same quality as its prebroadcast form.

Once the productions are constructed, they can be translated into audio form by use of a modem and then either stored on audio tape for later broadcast or sent out immediately upon creation by the production microprocessor. The advantage of intermediate storage on an audio tape is that in the event of a problem with the microprocessor, the flow of the presentation will not be interrupted. However, it is also perfectly reasonable to store information in the microprocessor system in parallel digital form when desirable or to generate it for direct transmission when storing is not desirable.

The rate at which the information is sent through the broadcast channel in a simple system using present technology would be between 300 and 50,000 bits per second. The lower rate would use the most readily available and least expensive modem and would be adequate to produce a powerful Programmed Video system. As the rates are increased, the capabilites of the system would more nearly approach and finally surpass those of broadcast television.

The modem signal would be received by a standard radio receiver and then translated into digital form with a demodulator working at the same baud rate as was used at the transmitter. Before this translation took place, the signal could also be recorded on an audio tape using a standard inexpensive consumer audio recorder. Such recording would be equivalent to a video tape recorder in television, but would be tremendously less expensive in terms of tape and equipment. Once the microprocessor receives the information and uses it to control a video machine, the presentation to the audience would be complete.

In the simple system the microprocessor could have the capability of producing a resolution of about 200 by 200 points on the video screen with a choice of four colors and eight different intensities for each point. With this kind of resolution and a fast transfer rate such as 50,000 bits per second we could expect to have about two full color slides per minute transmitted. If, on the other hand, we looked at the limits of the system as being a 40 by 40 resolution with each point being either black or white, we would get about one frame every five seconds from the 300 baud rate and about 30 frames a second at the 50,000 baud rate. The two extremes of resolution are chosen as being values in which, in one case, a reasonably good full detail picture can be sent and, in the second case, a reasonably good cartoon can be sent. In actual production the information transfer rate would be speeded up in many cases due to the fact that the entire picture need not be sent for each presentation. In the case of an animation, only the part of the picture which changes must be sent. In many other cases proper coding of the information allows an apparent transmission rate which is higher than the actual rate. Indeed, productions in which the video is entirely under the control of the receiving microprocessor need only a fixed length of transmission time for sending the programmed instructions. Once received, the instructions control the video set for as long as desired. In these circumstances the view on the screen can change continually, independently of the modem rate.

Different standards of information coding can be handled by different programming. There is much less need of setting standards since the programs in the microprocessor can be quickly adapted to a new form of information flow.

4. INITIATING THE SYSTEM

4.1 HARDWARE

Technically, the Programmed Video system would be quite easy to create. Given that there is existing radio transmitting equipment which can be used, the cost of setting up the hardware for production and broadcast would range between five thousand and one hundred thousand dollars. The cost could be as low as five thousand dollars if one wanted to economize and would not need to exceed one hundred thousand dollars even in a fairly elaborate system. On the receiver end the individual receiver could be put together from commercially available components selling for under two thousand dollars. With careful designing and economy of scale, the cost of the single receiver might be reduced to two hundred dollars.

These costs make it feasible for an entity such as a small country to set up a pilot system with local funding or by obtaining money from a development agency grant. A pilot project could study the workings of the system with a small number of receivers for the purpose of developing a saleable product. Initially, the system could use the entire audio channel of an existing radio station to transmit digital data. This would be done by scheduling some of the broadcast time for exclusively digital transmissions. Later it would be convenient to combine standard audio and digital data into a single signal which would be received as only audio by receivers not prepared for digital data. Thus the digital signal would be an enrichment of the audio signal for those prepared to receive it.

4.2 SMALL COUNTRY FEASIBILITY

Since a Programmed Video system is relatively simple to set up, the question of whether it is feasible or not for a small country is a matter of whether the capabilities are worthwhile for the country's goals and whether the costs are within the country's ability to pay. Capabilities of a Programmed Video system seem best described in terms of the capabilities of a television system which countries not having television might find desirable to have. Programmed Video would supply much of the same value in terms of entertainment and could be considerably superior in terms of educational value. In addition to the educational value of the productions, a Programmed Video system would have a tendency to produce microprocessor programming capabilities in the audience as a side effect of having a microprocessor available for learning in the home. Such capabilities could favorably affect economic productiveness.

In addition to the requirements for hardware, a Programmed Video system would need a production team. The production team would consist of at least five people. Therefore, the cost of salaries for five people is a serious consideration as to whether a Programmed Video system is feasible for a small country. If the capabilities of Programmed Video were attractive, a country of one hundred thousand could adequately support a production staff for a Programmed Video system.

Since Programmed Video is similar to television, many countries will want to consider which of these alternatives is more appropriate. Although there are advantages in both directions, one of the ways in which Programmed Video would be attractive, if a country were so inclined, is that Programmed Video would be a new area in which a country could have a significant impact upon the world with less competition from established interests. By contrast, in television a small country would have very little impact upon the world market and would be mostly a consumer of products from the rest of the world. Indeed, in Programmed Video a small country could conceivably create virtually all of its own productions whereas most television productions would be purchased outside the country. A secondary market with worldwide potential for recordings of Programmed Video productions is personal computer users.

4.3 ASPECTS OF PRODUCTION

Since the production of Programmed Video is new, there would be unique problems to solve in forming a production team. However, developing presentations should be closely related to the production of television on the one hand and of computer software on the other. Since Programmed Video productions can be used both for local broadcasting and for world wide sale to owners of microprocessors in recorded form, consideration must be made as to whether the content of productions should stress themes of local or worldwide interest. If the production team is formed in a small country, it is likely that it would be necessary to have expatriates fill at least some of the positions in the team. Careful consideration should be made about the work conditions that professional people will require, both for the benefit of the people on the team, and in relation to the impact on the rest of society which is produced by the existence of the team. Productions by outsiders for local consumption will have problems in maintaining appropriate cultural context as well as problems of political acceptance. The construction of a team containing expatriates should include from the very beginning local counterparts to train for all positions in the team as well as a provision for training expatriates in cultural values.

Some job classifications which might be included in a Programmed Video production team are graphic artists, script writers, musicians, communications technical people, computer people, producers, system designers and evaluators (particularly of the behavioral science sort such as applied psychologists), and mass communication people on an academic level. Many different sorts of people could contribute to the production team. One of the considerations in forming a team should be to form a team, not a group of separate individuals. It is much easier to choose an individual at a time with regard to nothing but that individual's past accomplishments. When consideration is made of the relevance that past accomplishments have to the present task and the ability of the individual to perform within the team, a more productive work situation can often be created.

Programmed Video can be labor intensive. Large amounts of labor are needed because production of presentations is more a matter of constructing than recording. Such labor will benefit from good feedback as to its quality. The production system should be a system in which feedback on the results of the labor controls the working of the system. In one form this would mean the following. A team produces presentations. Presentations are sold for money. Money resulting from sales returns to produce higher wages and more support for other productions. This type of positive feedback has a tendency to produce more and bigger accomplishments or to die a natural death if it is unsuccessful.

5. CONCLUSION

Broadcast Digital Programmed Video should be an exiting new medium which requires comparatively small investments for large potential returns. One of its capabilities should be to fill the perceived need of many developing countries for broadcast television at a lower cost and with greater benefits than would be the case if a broadcast television system were actually created. Since a small country can perform technological leap-frogging with such a system, it might also be a method of obtaining prestige in the international community.